

MODERN Machine Shop

HOWARD CAMPBELL, Editor

Volume 8

MARCH, 1936

Number 10

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Magazine
for
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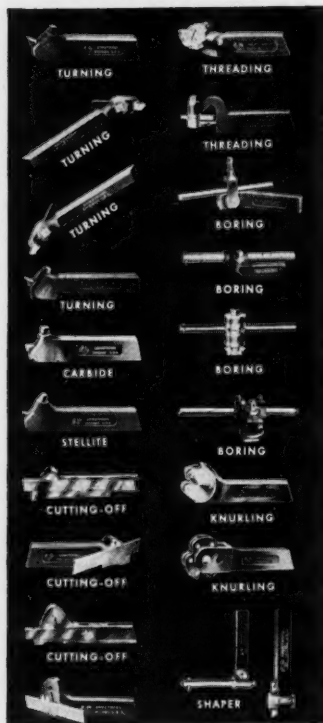
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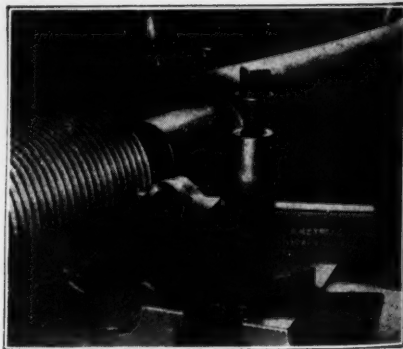
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MODERN Machine Shop

CINCINNATI, OHIO

MARCH, 1936

VOL. 8, No. 10

Radiographic Inspection of Metal Products

In this article the author presents a general idea of the applications and possibilities of modern industrial X-ray equipment.

By HERBERT R. ISENBERGER

St. John X-Ray Service, Inc., Long Island City, N. Y.

DEFFECTS in the interiors of metal objects are troublesome and sometimes costly to both the manufacturer and the user. For the former, such defects frequently increase manufacturing costs through rejection of the finished; for the latter, they often cause damage to equipment, personal injury, or loss of life when a part which has passed all inspections and put into service gives way because of some hidden flaw.

Testing methods that make possible the detection of such flaws without the subjection of the specimen to possible, if not actual, destruction are few, but radiographic examination is one, and one that is continually finding wider application. The X-rays provide us with a means of seeing into and learning a great deal about the interiors of metal articles without in any way damaging the objects. Therein lies the immense value of the application of radiology in industry—

a value which is only now beginning to be thoroughly appreciated.

The application of radiology to metal manufacturing as a means of

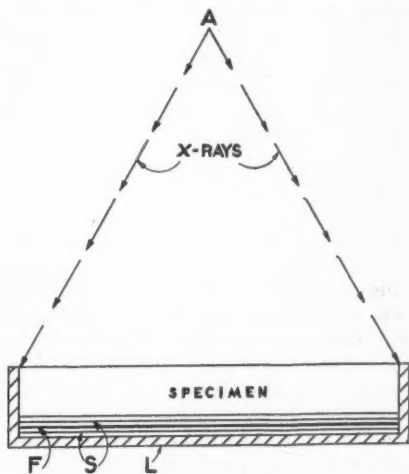


Fig. 1—Diagram showing arrangement of X-ray tube, film, and subject.



Fig. 2—Installation of X-ray equipment used for the examination of steel castings in a foundry.

detecting hidden flaws and defects is not new; it has been employed for a number of years by some of the larger and more progressive firms. The establishment of commercial X-ray laboratories at various points about the country, of which the St. Johns X-Ray Service is one, has brought the use of radiology within the reach of all manufacturers, both large and small, and the use of this science is increasing.

The fact that the interiors of solid structures can be examined without cutting into them has a high potential value. The cost of engineering work on castings, for instance, is considerable and as the size of the casting or forging increases the machining cost increases in proportion. To discover a flaw in a casting after a large part of the machine work has been done means that all of the processing cost thus far has been wasted and may amount to enough to wipe out all the profit that might have been made on the job. A radiographic examination of the job would have

disclosed the cracks or holes in the casting and might not only have saved subsequent machining expense but would have eliminated delay in production schedules.

There are two important fields for the application of radiology in foundry practice, one of which concerns the development of manufacturing technique, the other the final inspection of the product. At first thought the method might seem expensive, but there are many cases where the possible failure of a casting might cause damage far in excess of the cost of the test. Here radiographic examination becomes a matter of insurance.

The rapid development of high pressure steam installations, high head hydraulic power, high pressure oil-cracking systems, and other modern industrial developments present increasingly numerous cases where radiographic tests are not only an advantage, but are necessary. While the necessity may be more frequent in the case of castings, it also applies to forgings and bar and plate stock.

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It is also a reliable method of determining the soundness of a weld.

With the development of automatic welding equipment, welding is being more and more employed in metal fabrication. There are many cases where a nondestructive test is desirable in order to prove the soundness of the weld and at the same time provide assurance that the unit or part will withstand the strains imposed upon it in service, thus removing all doubt from the user's mind. X-ray inspection is especially valuable as a final check on welded seams in pressure vessels.

In the application of radiology, shadow pictures are obtained which clearly indicate any variations in the density of the material of which the subject is composed. These pictures are obtained as a result of the penetration of X-rays, produced electrically by the use of an X-ray tube, or of Gamma-rays, which

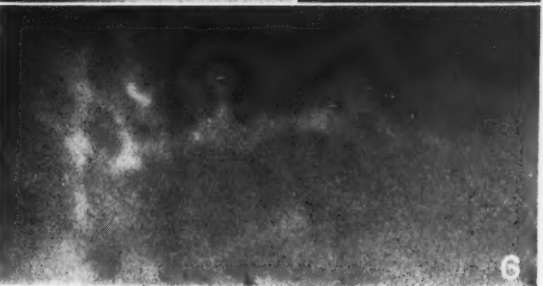
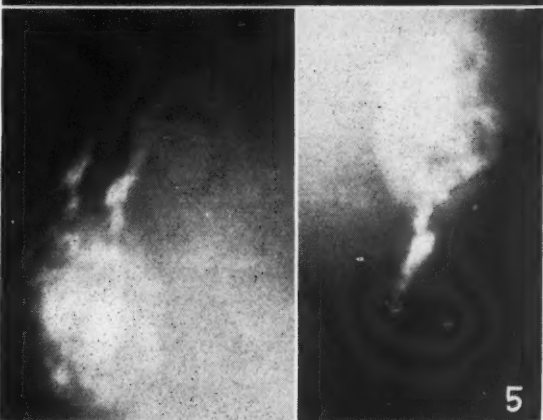
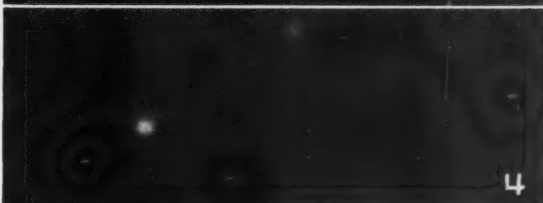
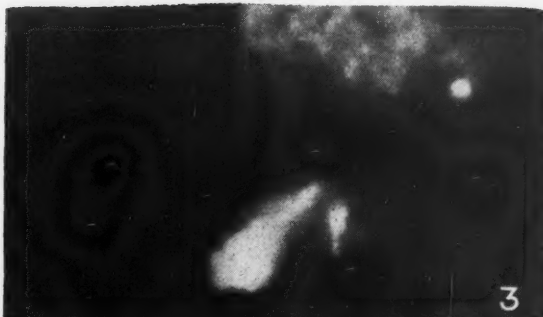


Fig. 3—Exograph of section of steel casting showing sand inclusions around the chaplet.
Fig. 4—Exograph showing existence of gas cavities due to imperfectly deoxidized metal.
Fig. 5—Exograph showing large sand pocket in a steel section of 2½-in. thickness.
Fig. 6—Exograph showing pipe or primary shrinkage caused by failure of the risers to function.

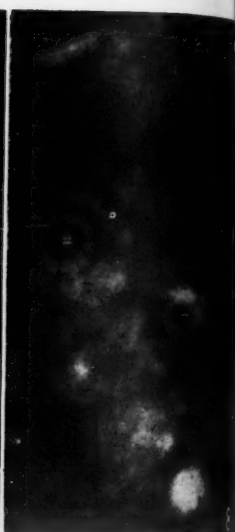
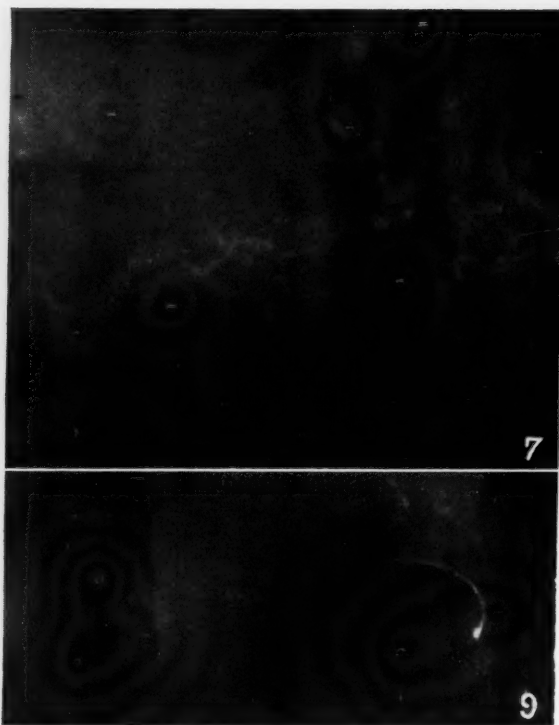


Fig. 7—Exograph showing hot tears in metal caused by cooling stresses set up after metal has solidified but while still in "tender" stage. Fig. 8—Exograph showing gas condition in casting. Fig. 9—Exograph showing rupture in wall of pressure vessel probably caused by the same test in which the vessel was passed as satisfactory.

emanate from radium. Gamma-rays are of much shorter length than X-rays, but penetrate deeper. X-ray pictures are known as "exographs" to distinguish them from the "gamma-graphs" produced by means of Gamma-rays.

As with photographs made by the ordinary process, darker regions on the negative or the correspondingly lighter regions on the print mean that more of the rays passed through the object at those points, indicating that the object is more transparent at the places under discussion. When the rays are impeded by a more dense structure, perhaps caused by the inclusion of something made from an element of greater atomic weight,

the area of the negative covered by the structure referred to will be lighter and the print will be darker. The absorption of the rays grows with the atomic weight of the material under examination. The atomic weight of lead is so much greater than that of other elements that lead is used to shield the source of the rays, thus protecting the operator. A sufficient thickness of lead will absorb X-rays completely, and about 1 per cent of Gamma-rays will penetrate 2 inches of lead.

A diagram of the radiographic arrangement is shown in Fig. 1. The focal spot A, which is either the target of an X-ray tube or the bulb containing the radium, should be as small

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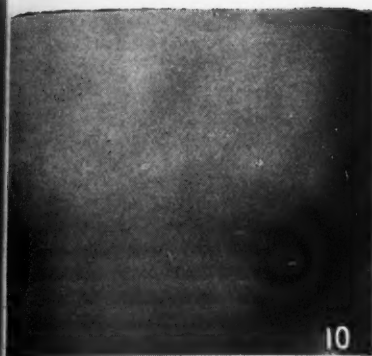


Fig. 10—Exograph of a section of sound steel.

as possible in order to obtain sufficient fine detail on the film E. In order to reduce the time required for an exposure, the double-coated film is placed between two intensifying screens S. A thickness of lead L forms a backing which protects the film from being fogged by scattered radiation.

X-ray tubes are now available which operate at 300,000 volts and 10 milliamperes continuously, thus enabling the penetration of 4 inches of steel within 10 minutes. Gamma rays should not be used to make a radiograph of a section of steel less than 3 inches thick, due to the fact that these rays are

too penetrating and will not produce the fine detail and great contrast needed to show fine cracks or other minute defects.

Gamma-rays can, however, be employed to great advantage on thicknesses of steel greater than 4 inches and up to about 8 inches. The appearance of the various defects is very similar regardless of whether the subject is a casting or a welded seam, but the precision in X-ray inspection can be raised as much as 1 per cent on a section of 2 inches or less, and to 4 per cent when Gamma-rays are used. This holds good particularly where blowholes lie in the direction of the rays.

An actual installation of X-ray equipment for the examination of heavy steel castings in a foundry is shown in Fig. 2. The X-ray tube is located in a lead-lined safety box which, in turn, is enclosed in a sheet iron case that is placed where the parts to be inspected can be moved into position directly under it. The

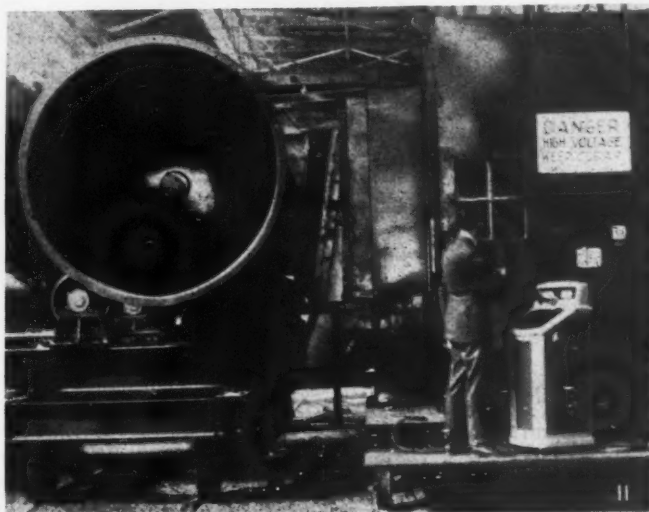


Fig. 11—Installation of X-ray equipment for inspection of welded seams in pressure vessels.

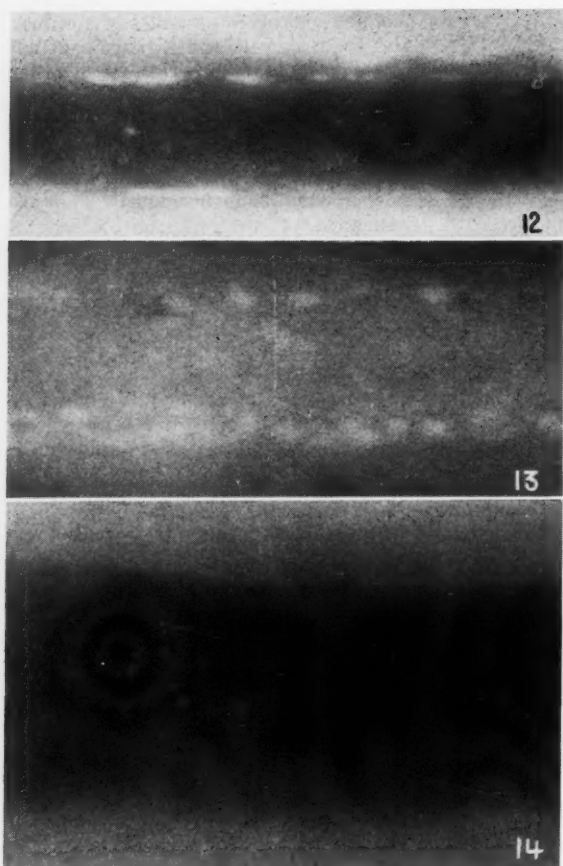


Fig. 12—Exograph of a weld showing lack of proper fusion between weld metal and parent metal. Fig. 13—Exograph of weld showing improper fusion and slag inclusions. Fig. 14—Exograph showing gas inclusions in weld.

shield. At the right in the illustration is the darkroom for the development of the films.

X-ray tests confirmed by cutting into the castings and making an examination indicate that casting defects may easily be classified, all of which classes are traceable to definite and simple causes. Most of these causes, if not all of them, can be eliminated by proper foundry methods. Experience shows that when defects have been corrected by making the required changes in foundry practice, they tend to stay corrected. It is thus possible, by the use of radiography, to eliminate

film is placed in a special cassette which can be seen projecting from the end of the casting in the illustration. During the exposure of the film, the casting is surrounded by a lead-lined housing which prevents the rays from passing out into the surrounding area. The high-voltage current required to operate the tube is produced by special transformers and rectifiers in a sheet iron room just behind the control stand. Thus the high-potential equipment is completely enclosed in a grounded metal

approximately 85 per cent of the more important defects in casting production.

The principal defects in steel castings, as revealed by radiographic examination, may be classified as follows:

1. Gas, slag and sand pockets due to loose dirt in the mold. Fig. 3 is an exograph of a part of a steel casting, 1½ in. thick, showing the existence of a large gas pocket and sand inclusions around the chaplet.

2. Gas cavities due to imperfectly

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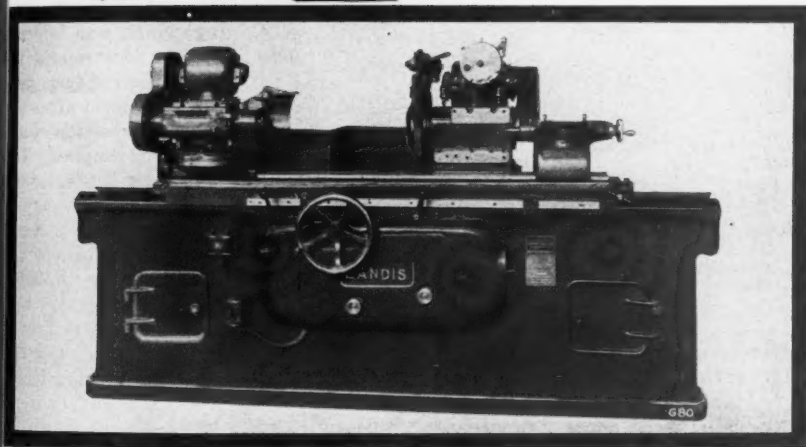
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deoxidized metal, as shown in Fig. 4.

3. Sand inclusions due to cutting of the mold or runners. The illustration Fig. 5 shows a large sand pocket in a steel section 2½ inches thick. This defect was found in one of the headers shown in Fig. 2 ready for examination. By making a double exposure of this spot, it was determined that

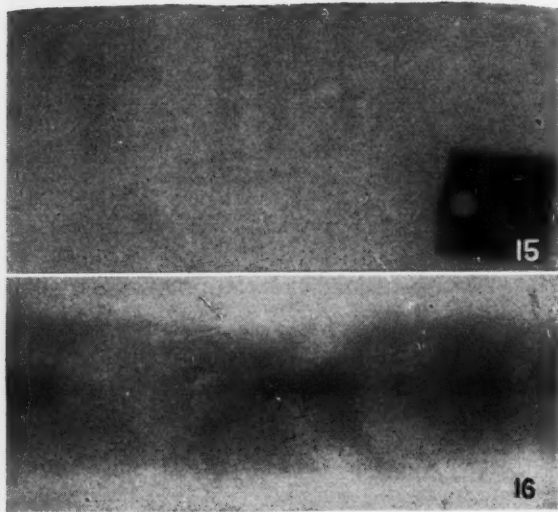


Fig. 15—Typical exograph of a sound weld. Only by reference to the markers can the weld zone be determined.
Fig. 16—Exograph of a sound gas weld.

the inclusion started close under the outer surface and did not penetrate more than one-quarter of the way through the wall; hence it was passed as being solid enough for the job.

4. Shrinkage cavities due to imperfect feeding, part of the casting solidifying while the pouring was still in process.

5. Pipe or primary shrinkage caused by failure of the risers to function as indicated. An example of this condition is shown in Fig. 6.

6. Hot tears caused by cooling stresses set up in the metal after it

has solidified but while it is still "tender." Such a fracture usually results in a system of cracks as shown in Fig. 7.

7. Spongy metal, as shown in Fig. 8. The volume of metal is greater in the liquid state than in the solid, and when it solidifies a definite cavity may be formed, or a region may contain

many minute cavities forming what is known as spongy metal.

8. Shrinkage cracks emanating from a sinus-like cavity developed during the cooling process.

9. Rupture developed during pressure test. In Fig. 9 is shown a portion of a steel casting which was selected by the customer's inspector as being particularly good after the usual inspection tests had been applied. The exograph revealed sharply-defined cracks starting from a small cavity or inclusion. The casting was probably ruined in the very test in which it was proved

good. Although in the illustration the fracture appears to be circular, it appears so because of the cylindrical contour of the wall in which it occurred.

For purposes of contrast, an exograph of a section of sound steel is reproduced in Fig. 10. The parallel bands at the lower part of the piece are screw threads cut in the interior of the casting wall. The light spot in the lower right hand corner is not a defect, but is the inner end of a hole drilled through the wall of the

(Continued on Page 162)

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Nickel Alloy Constructional Steels

By D. A. NEMSER

The International Nickel Company, Inc.

A STEEL may be defined as an alloy consisting essentially of iron and carbon and possessing initial malleability. An alloy steel embodies these characteristics plus special properties imparted to it by one or more alloying elements. Nickel plays an important role in the alloy class of steels, due to the fact this element increases hardness, elastic properties and strength without loss in ductility, due primarily to its

structure, thus minimizing heat treatment distortion, scaling and wear and tear of the furnace equipment. By lowering the rates of transformation nickel exerts a refining action on ferrite and pearlite thereby inhibiting grain growth and embrittlement.

The straight nickel steels are represented in the SAE classification by the 2000, 2100, 2300 and 2500 series. Because of its intensifying effect when employed with other alloy

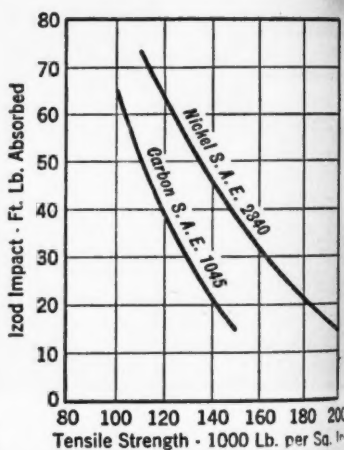
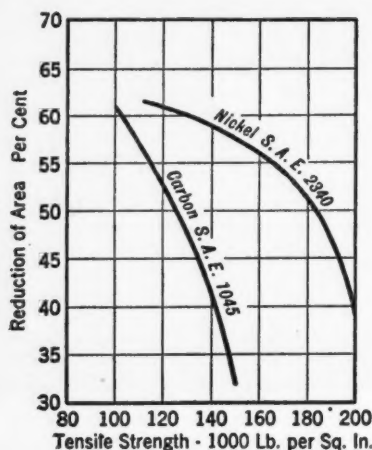


Fig. 1—Ductility and impact resistance of medium carbon steels, with and without nickel.

complete solubility in ferrite in all proportions.

The critical point and eutectoid ratio are lowered by the inclusion of the nickel and a depressed critical point lowers the hardening tempera-

ture. nickel is a dominating alloy in the alloy steel field. The various combinations of nickel chromium, nickel molybdenum, nickel chromium molybdenum and nickel vanadium in constructional steels offer advantages

TABLE I
Comparison of Critical Cooling Rates of Carbon and Nickel Steels
(of medium grain size)

Carbon in Steel, %	Approximate Critical Cooling Rate, °F. per sec., for	
	Carbon Steels	3% Nickel Steels
0.20	1260	78
0.40	920	62
0.60	600	42
0.80	290	32
1.00	325	40
1.20	415	50

properties which cannot be obtained by the use of equivalent amounts of any of these alloys alone.

The nickel chromium series are classified in the SAE as the 3100, 3200, 3300 and 3400 groups. It is interesting to note the recent addition of X-3140 to the 3100 family. The chromium content of this grade is somewhat higher than is found in 3140. This modification has advantages in sections over two inches.

The nickel molybdenum series are the 4600 and 4800 groups. SAE 4620, 4640, 4815 and 4820 are recent additions. Although nickel-chromium-molybdenum steels have been used in industry for a long time, this family has only recently been added to the SAE list as the 4340 and 4345 grades.

In a discussion of alloy steels, the importance of McQuaid-Ehn grain size must not be underestimated. This important property has a very definite effect on the hardening characteristics of a steel. As is well known, the test for grain size consists in subjecting a specimen to a carburizing treatment for 8 hours at 1700 deg. F. After slow cooling to permit the formation of a pearlitic structure, with the excess cementite outlining the grains, a micro-section is prepared and the carburized zone

is examined at 100 diameters magnifications, then the grain size is compared to an A.S.T.M. standard chart which lists eight sizes.

Grain sizes 1 to 5 are considered "coarse-grained" and are generally characterized by complete carbide envelopes in the hypereutectoid zone. Grain sizes 5 to 8 are considered "fine grained" and are generally characterized by incomplete carbide envelopes in the hypereutectoid zone. Fine grained steels are tougher, possess higher impact strengths, and are less liable to distort and crack in hardening than are the coarse grained steels. The latter carburize at a somewhat faster rate. From this summation it is obvious that a fine grained product is desirable for the majority of applications.

Since a fine grained steel will not coarsen markedly except at high temperatures, it has become common practice to pot-quench carburized parts of fine grained steels. This treatment greatly curtails the hardening operation and minimizes distortion. In many plants this procedure is modified by allowing the pots and contents to cool somewhat before quenching.

One of the fundamental functions of an alloying element like nickel is to impart toughness at high strength.

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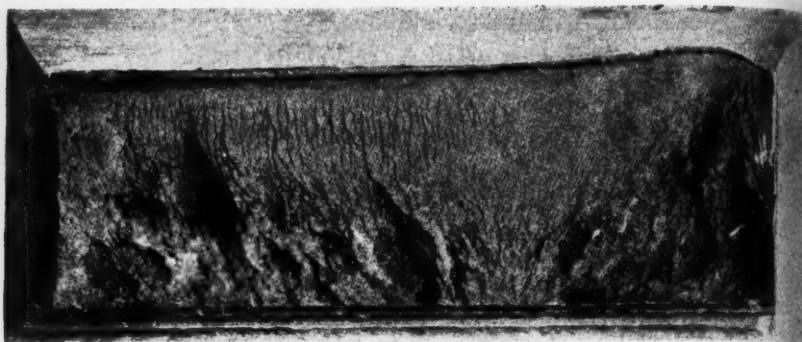


Fig. 2—Photograph of cross-section of a 6 x 6-in. block of air hardened steel. Note uniformity of hardness from surface to center.

(Illustration courtesy A. Finkl & Sons Co.)

or conversely, superior toughness at lower strengths. A quantitative evaluation of the toughening effect of nickel is shown in Fig. 1. This illustrates the large increase in impact resistance and reduction of area obtained in quenched and tempered steel by the addition of 3½ per cent of nickel.

A major characteristic of plain carbon steel is its shallow hardenability. In improving the depth hardening properties by the proper use of alloy, many benefits are secured, such as response to milder coolants, reduction in warpage and distortion, and, in the case of nickel, lower heat treating temperatures. In order to obtain the most desirable combination of strength, ductility and toughness in a piece of steel, it is necessary to

harden it by quenching and then temper or draw back to the desired strength. But unless the hardening is effective, the efficiency of the whole treatment is lowered.

In order to fully harden steel, it must be heated to a temperature above the upper critical point and then cooled at a rate sufficiently to hold the austenite existing at the high temperature to martensite, its first decomposition product. If the cooling speed is below this critical cooling rate, lower decomposition products such as troostite and sorbite will be formed and the steel will not be fully hardened.

The difficulty lies in the means of controlling the cooling rate. The ideal coolant would abstract heat uniformly from surface to centre at a

TABLE II

Properties at mid point of 6 inch solid forgings of low-carbon nickel steel, and 0.5% C un-alloyed steel normalized and tempered.

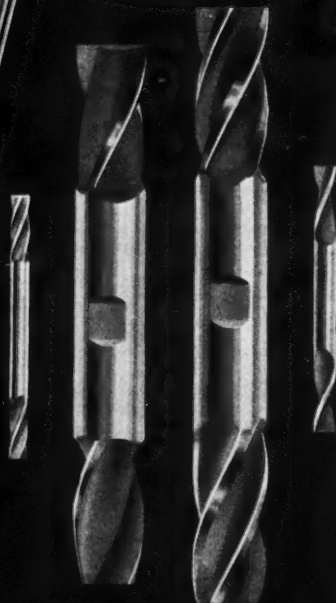
Composition, %			Yield Point lb./in. ²	Tensile Strength lb./in. ²	Izod Impact, ft. lb.	Fatigue		Brinell Hardness
C	Mn	Ni				Limit lb./in. ²	Ratio %	
.46	.64	51,300	86,200	16	40,000	47	167
.24	.94	2.70	57,800	87,800	86	54,000	61	183

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speed just above the critical cooling rate. However, since the common quenching media; water, oil and air, offer widely divergent cooling rates and since the cooling rate varies throughout a section, decreasing from surface to centre, this condition cannot exist. The existence of this cooling gradient causes internal stress, often resulting in cracking.

The cooling velocity under fixed conditions decreases with an increase in mass. Thus at relatively small sections, a size is reached above which it becomes impossible to fully harden an unalloyed steel to any appreciable depth. This size varies somewhat with carbon content and grain size. Coarse-grained steels have a lower critical cooling rate, and, therefore, harden somewhat deeper than a fine grained material of similar chemistry. Despite these variables, however, unalloyed steels are essentially shallow hardening.

The influence of the alloying elements in reducing the critical cooling rate is profound. The effect of nickel in this respect is shown in Table I. When properly employed in conjunction with chromium and molybdenum, nickel will reduce the cooling rate to so marked an extent as to render a steel air hardening. This is illustrated in Fig. 2. Here is pictured a cross-section of an air hardened 6x6-in. block of steel. The uniformity of hardness from surface to centre is most striking.

It is becoming more generally recognized that, for a great many applications, the tensile strength is only partially indicative of the suitability

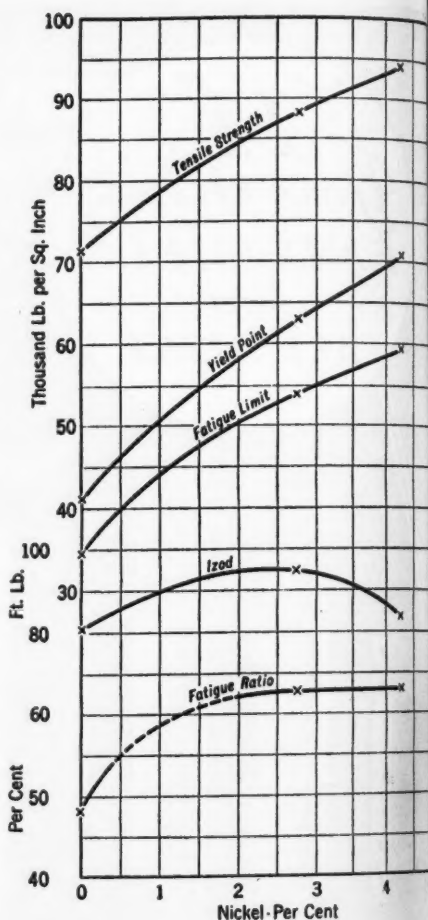


Fig. 3—Physical properties of 6-in. dia. forgings (solid) normalized and drawn 0.20/0.25 per cent. C. Mid-section tests.

of a given material. Factors of fatigue and impact resistance are often more important. A careful investigation into the fatigue resistance of normalized forgings of rather heavy sections such as might be used in locomotive construction or heavy shafting has shown the influence of carbon in reducing the fatigue ratio

Reduce die making costs by this modern method

TEDIOUS fitting and filing methods of locating punches in metal working dies are becoming a thing of the past. The use of Cerromatrix greatly reduces the cost, time and uncertainty of die making because:

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(ratio of fatigue resistance to tensile strength). Since tensile strength and actual fatigue strength go down with carbon content, it becomes necessary to resort to a means of reducing carbon without sacrificing a proportionment amount of strength. This may be accomplished through the introduction of nickel. Table II and Fig. 3 demonstrate this fact.

A great many fatigue failures are induced by stress concentrations due to the notch effects introduced by poor design, tool marks, and so on. In many cases, particularly in the harder steels, an increase in strength, although accompanied by higher fatigue resistance in tests on smooth, polished test pieces, will result in quicker failure under these conditions because stress concentration effects become more pronounced as hardness

goes up. The superiority of nickel steels over plain carbon steel is maintained in the presence of stress concentration effects. However, designs embodying bad stress concentrators represent poor engineering and should be avoided in practice.

From the above discussion it might be inferred that the choice of an alloy steel might be simple. Unfortunately, such is not the case as a number of complicating factors become apparent. These include size of section, complexity of section, strength level at which toughness and ductility are required, economic factors, and others which must be balanced for any individual application.

In order to illustrate the diversification of nickel bearing steels in the tool and die field, the following chart is included:

Applications of Nickel Alloy Steels in Tool and Die Fields

Application	Material	Treatment
Arbors	SAE 3120, 4615	Case Harden
	SAE 3170, 3270, 4370	Oil Harden
Boring Bars	SAE 3145, 3160, 3250, 4650	Oil Harden
Broaches	SAE 2315, 3312, 4615	Case Harden
Calking Tools	SAE 2340, 3340, 4640	Oil Harden
Chisels	SAE 2350, 3250, 3350, 4650	Oil Harden
Collets and	SAE 2315, 3120, 4615	Case Harden
Collet Fingers	SAE 3170, 3270, 4370	Oil Harden
Dies, Blanking	SAE 3430, 3440	Oil Quench from Cyanide
	SAE 3350, 3455, 4660	Oil Harden
Dies, Cold Heading	SAE 4345, Ni W	Oil Harden
Dies, Die Casting	SAE 3150	Oil Harden
Dies, Deep Drawing	Ni W	
Dies, Drop Forging	SAE 2160, 3150, 3440, 4345	Oil Harden
Dies, Forming	SAE 3250	Oil Harden
Dies, Hot Work	Ni-Cr-W-Mo	Oil Harden
Dies, Plastic Molding	SAE 3110, 4610, 2% Ni Ingot Iron	Case Harden
Gages, ring and thread	SAE 3170, 3270, 4370, 4670	Oil Harden
Hacksaw Blades	Ni W	
Hammer Heads	SAE 3140, 2340, 4640	Oil Harden
Hot Shearing Knives	SAE 2340, 4345	Oil Harden
Knives, Circular and Wood Planing	Ni W	
Milling and reamer cutter bodies	SAE 3150, 4640, 3240, 3330	Oil Harden
Punches	SAE 2350, 3250	Oil Harden
Saws—Band and Circular	2% Ni High Carbon	
	SAE 4660	Oil Harden
Screw Drivers	SAE 3150, 3250, 4350, 4650	Oil Harden
Wrenches: Pipe, Box, Open End, Socket	SAE 3150, 3250, 4650	Oil Harden

3110, 3170, 3270, 3350, 3455, 4350, 4370, 4610 and 4650 are not S.A.E. steels but follow the S.A.E. system of numbering.

The following special steels are also listed.

	C	Mn	Si	Ni	Cr	W	Mo
2% Ni Ingot Iron	.05Mx.	.13-.18		2.00-2.25			
2% Ni High Carbon	.65-.75	.50-.80	.15-.30	1.75-2.25			
Nickel Tungsten	.82-.92	.50-.80	.15-.30	.50-.70		.90-1.10	
Nickel, Chrome, Tungsten, Moly	.24-.40	.50-.80	.15-.30	1.75-3.50	2.50-3.50	6.00-10.0	.30-.50

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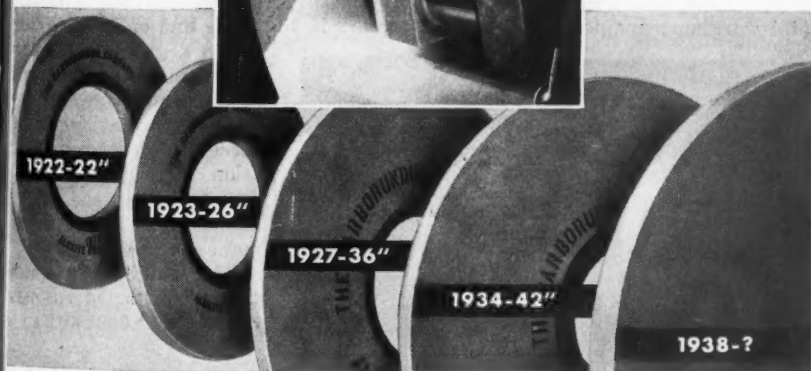
It has been produced to meet industry's need for closer tolerances, more perfect finishes and lower wheel costs in crank grinding operations. It is one more development in a succession of crank grinding wheels that have each set new standards of crank grinding. For the rough forged crank The Carborundum Company produced the "60" Bond Wheel for rough and finish grinding. Then the "30" Bond Wheel for turned cranks

where stock removal was reduced and closer tolerances and better finishes were required.

Now the "180" Bond Wheel. It has all the refinements necessary to do a better job of crank grinding and it goes hand in hand with the economical advantage of the increased wheel diameter.

Other recent Carborundum contributions to industry include an improved complete line of foundry grinding wheels—the sensational Aloxite "AA" and "280" Bond Tool Room Wheels.

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A Chicago Tool Shop

BY DONALD A. CLARK

MANUFACTURERS of metal products in the Chicago area are very lucky indeed in having available a number of high grade tool and die shops, equipped with modern tools and manned by skilled artisans of the highest qualifications. One such shop is the plant of the Boyar-Schultz Corporation, 2110-2124 West Walnut Street. Equipped with a variety of metal working machines ranging from

bench filing machines to a horizontal drilling and milling machine, the firm is in position to turn out practically anything in the way of a tool, fixture, jig, or die that may be required.

Both Mr. Boyar and Mr. Schultz have had approximately 25 years of experience in tool work, and the foreman, Mr. Worum, has had some 30 years in the same line of work. Which

means a great deal to the customer, because experience is undoubtedly the most important factor in successful tool shop operation. Mr. Schultz handles the sales end of the business, and Mr. Boyar manages the plant.

The building in which this firm started business contained 5,000 square



Fig. 1—Part of the line of shapers.

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EARLY anyone could make a motor. The fundamentals of motor design are the textbooks of every engineering school. But more than fundamentals are required.

under strain in installation or operation . . . dynamic rotor balancing and vibrometer tests for smooth running.

You'll find all these little *big* things that make for longer motor life and more successful performance in Fairbanks-Morse motors. The little *big* things that give you more for your money every time. Before you buy, investigate what extra advantages F-M motors can give you. Address Department F-841, Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Illinois. 34 branches at your service throughout the United States.

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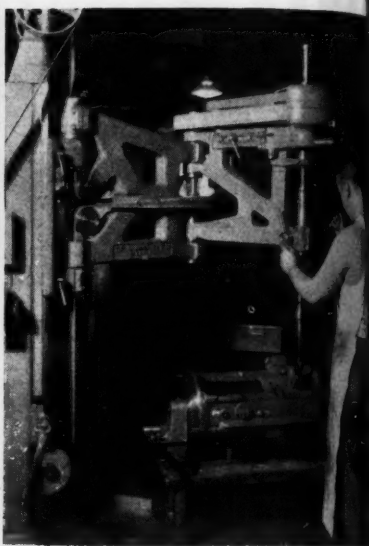
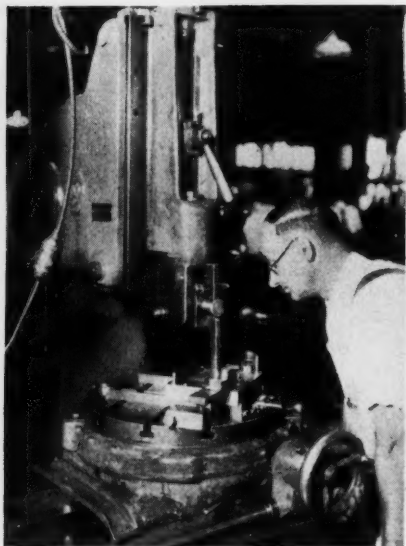


Fig. 2 (Left)—This Pratt & Whitney vertical shaper is one of the busiest machines in the shop. Fig. 3 (Right)—Trying out a new jig. This light radial drill is handy for trying out new tools to see how they will work in production.

feet of floor space; the present building contains 25,000 square feet and at times the plant is pretty crowded. This increase in business is largely due to the fact that 100 per cent serv-

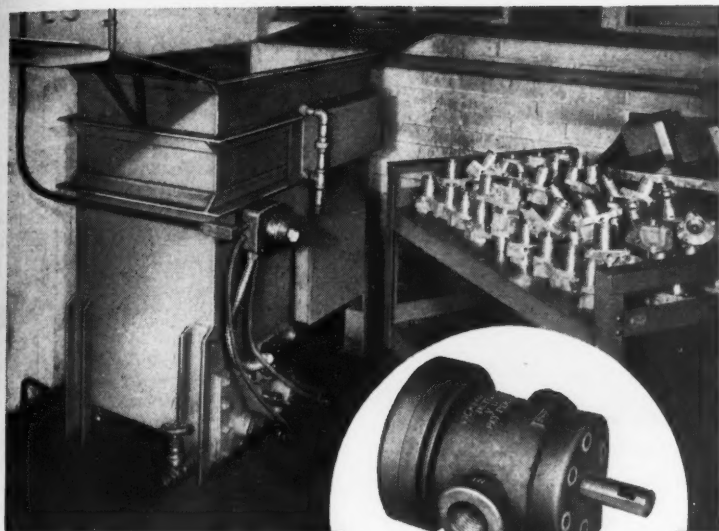
ice is the one object of the entire organization. The estimators and engineers are the best that can be obtained.

The firm makes a special feature of planning, designing, and building complete outfits of tooling for the manufacturing of metal products of all kinds. Thus a manufacturer has only to submit a model or drawing showing the design of the product he wishes to make and the Boyar-Schultz Corporation will plan the operation in the most logical and economical order, and design and make the tools with which to



Fig. 4—Both tool and production are drilled with this American radial drill.

Why **VICKERS** uses **DETREX DEGREASING**



**VICKERS V-TYPE
ROTARY PUMP**

PARTS for Vickers hydraulic pumps, valves and controls are held to tolerances of 1 to 2 ten thousandths. Consequently machined surfaces must be perfectly clean for accurate gaging and inspection. The exterior must be prepared for a durable finish.

Prior to the installation of Detrex Degreasing all these parts were washed in gasoline and blown off with an air hose. Gasoline consumed, approximately 50 gallons per day by a gang of six washers.

The Detrex machine completely eliminates the former fire hazard, produces cleaner surfaces, provides for closer inspection, assures better finish and is decidedly more economical. One man handles the entire output.

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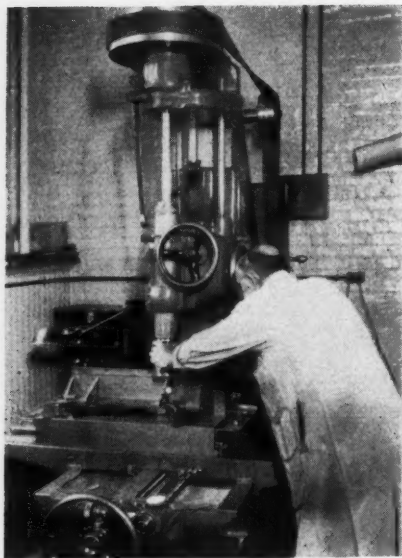


Fig. 5—Jig-boring machines have eliminated the necessity of using "buttons" in spacing and drilling holes in jigs and dies.

operations may be performed.

Indeed, they will also manufacture the product for the customer, if he wishes. And it is not uncommon for the customer to leave the manufacturing to Boyar-Schultz after the tools have been made. So much of this work has been turned over to them that a special manufacturing department has been created, equipped with light and heavy manufacturing machinery, punch presses, screw machines, and so on.

Included in the equipment is a No. 30 Gidding & Lewis horizontal boring machine, not shown. This machine will accommodate dies and other work weighing several tons.

Figure 1 shows a part of the line of Cincinnati and Gould & Eberhardt shapers, and Fig. 2 shows a diemaker slotting out a small die on a Pratt & Whitney vertical shaper. In Fig. 3

a mechanic is shown trying out a new jig by drilling one hole at a time in a Hammond light radial drill. A radial of heavier design is the American radial drill shown in operation in Fig. 4. This machine is used both for tool and production work.

Holes in jigs and dies are spaced and bored by the use of two Pratt & Whitney jig-boring machines one of which is illustrated in Fig. 5. The old method of spacing holes by the use of "button" has been rendered obsolete by these machines, the finest accuracy being possible through the micrometer attachments which form a part of the equipment of the machines.

The mechanic shown in Fig. 6 is trying out a finished die with the aid of a percussion press. While allow-

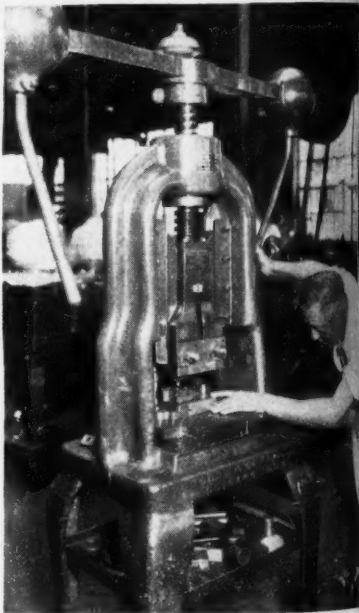


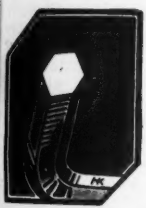
Fig. 6—Each new die is tried out under the percussion press.



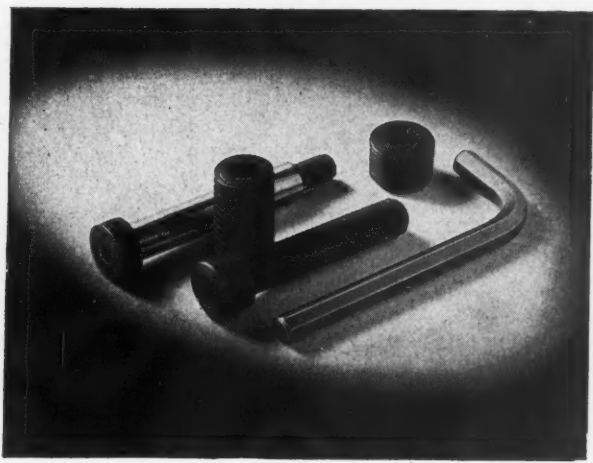
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Fig. 7—One corner of the Boyar-Schultz shop showing the die and toolmakers at work.

ing the finest of settings and adjustment of the die, enough pressure can be applied to produce a piece of work and thus discover just how the die will perform under production conditions.

Such a plant is a valuable asset

both to the small manufacturers who consider toolmaking a separate industry and who do not wish to go to the expense of maintaining their own tool departments, and to the large manufacturers who are at times unable to handle all of their own work.

KELLER EXPANDING RUBBER POLISHING WHEELS, SANDING DRUMS, ABRASIVE BELTS AND SLEEVES. This 4-page folder, issued by Pratt & Whitney Company, Hartford, Conn., contains illustration, descriptions, specification, and prices of the Keller Expanding Rubber Polishing Drums and other polishing equipment made by the above firm. Copy free upon request.

REX SOLVENT DEGREASING PROCESS. This 8-page bulletin, printed in two colors, is a complete exposition of modern degreasing methods. It describes the equipment and solvents used and presents examples of work where such equipment is in constant use. Copy free upon application to Detroit Rex Products Company, 13017 Hillview Ave., Detroit, Michigan.

GARDNER ABRASIVE PRODUCTS. The complete line of abrasive discs and wheels marketed by Gardner Machine Company, Beloit, Wis., is presented in a 16-page booklet now being issued by

the above firm. The book contains photographs and descriptions of the Gardner Red-Rim Wire-Lokt Abrasive Wheel, Yellow-Rim Wire-Lokt Abrasive Wheel, Gardner G. I. A. Discs, Gardner Wheel Dressers and other Gardner accessories used with Gardner abrasive discs and wheels. This book should be of prime interest to users of disc grinding equipment. Copy free upon request.

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Methods Engineering Procedure:

By H. B. MAYNARD,

President, Methods Engineering Council, Inc.
Pittsburgh, Pa.

IN order to show that formulas are not limited to comparatively simple work, but that they are flexible enough to handle almost any number of variable conditions, the cutting time charts for an engine lathe formula will be discussed.

The basic formula for cutting time on an engine lathe may be derived as follows:

$$\text{Total cutting time} = (\text{length of cut}) \times (\text{time per inch}) \times (f) \text{ number of cuts.}$$

$$\text{Time per inch in decimal hours} = \frac{.0167}{\text{Cutting speed}}$$

$$\frac{\text{Cutting speed}}{\text{diameter} \times \pi} \times \text{feed}$$

$$\frac{12}{\text{diameter} \times \pi}$$

$$\text{Total cutting time} = \frac{(\text{length of cut}) \times .0167}{\text{Cutting speed}}$$

$$\times (f) \text{ no. of cuts.}$$

$$\frac{\text{Cutting speed}}{\text{diameter} \times \pi} \times \text{feed}$$

$$\frac{12}{\text{diameter} \times \pi}$$

$$= (\text{length of cut}) \times$$

$$\frac{.0167 \times \pi}{\text{Diameter}}$$

$$\times \frac{12}{\text{cutting speed} \times \text{feed}}$$

$$(f) \text{ No. of cuts.}$$

Conclusion of fifth article, explaining the setting of rates by the use of constants.

Time Formulas for Rate Setting

In this equation, $.0167 \times \pi + 12$ is a constant, and the length of cut and the diameter of the part are obtained from the drawing. The cutting speed and the feed vary with material and machining conditions which also determine the number of cuts. Therefore in order to determine cutting time quickly and accurately, it will be necessary to analyze machining conditions in more detail.

The material of which the part is made has an important bearing on the feeds and speeds which are used to machine it. Where a number of materials are worked upon, simplification may be obtained by grouping together those materials which have similar cutting characteristics.

The rigidity with which the part can be held during machining determines the number of roughing cuts which are necessary to bring the part to approximate dimensions. The average amount of material roughed off in the machine shop is about $\frac{1}{4}$ inch on a side or $\frac{1}{2}$ inch on the diameter. For this amount of excess material, machining conditions or the nature of the job, overhang of tools, strength of section, and means of clamping or chucking may be classified as follows:

TABLE I

Finish	STRONG				MEDIUM				WEAK				Extra-rough cut	Extra-finish cut	Minimum diameter to be used, inches	
	Rough	Fin-ished	Fin-ished to	Fin-ished to	Rough	Fin-ished to	Fin-ished to	Fin-ished to	Rough	Fin-ished to	Fin-ished to					
Accuracy		± 0.010	± 0.003	± 0.003		± 0.010	± 0.003	± 0.000		Std.	± 0.010	± 0.003	± 0.000	16- or 24-in. engine lathe
Group 1	0.0013	0.0023	0.0034	0.0034	0.0019	0.0030	0.0040		0.0026	0.0036	0.0047	0.0006	0.0011			3 3/4
Group 2	0.0019	0.0034	0.0048	0.0048	0.0029	0.0043	0.0058		0.0038	0.0053	0.0067	0.0010	0.0014			2 3/4
Group 3	0.0026	0.0044	0.0062	0.0062	0.0039	0.0059	0.0077		0.0052	0.0070	0.0088	0.0013	0.0018			1 3/4
Group 4	0.0039	0.0064	0.0089	0.0089	0.0058	0.0083	0.0108		0.0077	0.0102	0.0127	0.0019	0.0025			1 1/4
Constants Turning or boring	0.0224	0.0422	0.0523		0.0253	0.0454	0.0553		0.0457	0.0616	0.0716					
Facing	0.0258	0.0456	0.0557		0.0356	0.0557	0.0656		0.0457	0.0656	0.0756					

Total boring, turning, or facing time = (length of cut) \times diameter \times constant \div tool constant.
Machining time chart for boring, turning or facing non-ferrous metals in 16-, 18-, or 24" engine lathes.

Strong Machining Conditions—Jobs of a rigid nature that can be held firmly without danger of breaking pulling out of chuck, having a good chucking grip so that high speeds can be used and excess material removed in two roughing cuts. The tool or the cutting tool will not have overhang greater than 4 inches.

Medium Machining Conditions—Jobs that can be held firmly and will not pull out of chuck when high speeds and three roughing cuts are used. The job may have an overhang ranging from 4 to 8 inches. In boring, the tool will have an overhang of 4 to 8 inches.

Weak Machining Conditions—Jobs that cannot be held firmly in the chuck, with thin sections, weak construction, or excessive overhang. Jobs of this kind require four roughing cuts.

The finished appearance which the machined surface must present will influence the feed of the final cut. Finishes may be classified as rough finish, and fine finish. The terms are self-explanatory.

The accuracy or the closeness which dimensions must be held at influences the number of cuts which must be taken. The accuracy desired is usually shown by the tolerances given on the drawing. Accuracy requirements may be divided into three classes.

1. Standard tolerances which range from $\pm .010$ on small work to $\pm .062$ inch on large.

2. Tolerances between $\pm .003$ and $\pm .010$ inch.

3. Tolerances between $\pm .000$ and $\pm .003$ inch.

The above analysis coupled with thorough knowledge of engine lathe operation permits the drawing up of a number of machining tables which will cover any kind of work which

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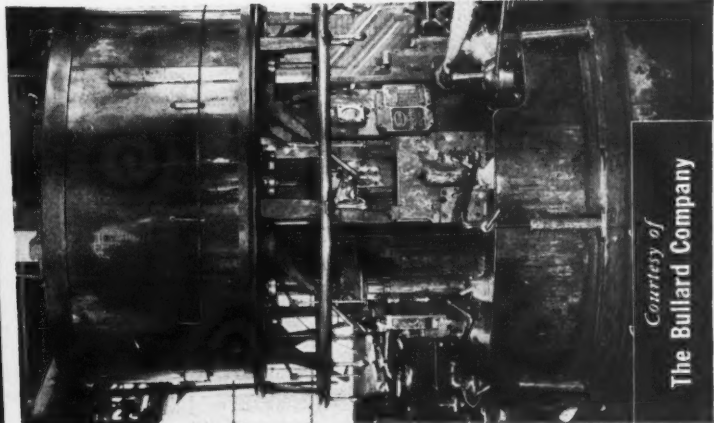
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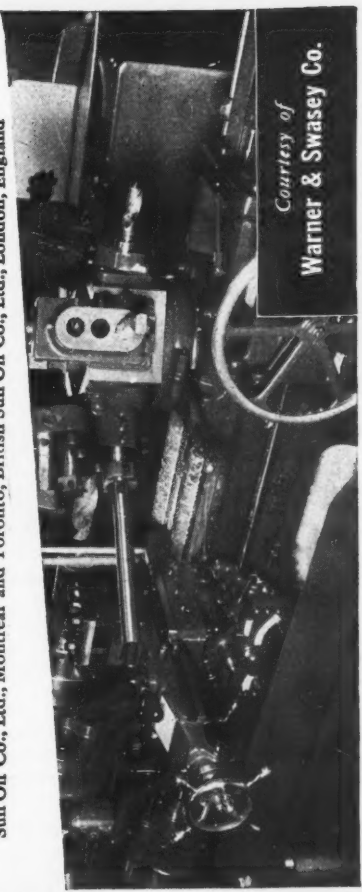
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done on engine lathes. Table 1 covers boring, turning, or facing non-ferrous materials held between centers, in a chuck, or with a chuck and center. The total boring, turning, or facing time is found by multiplying the length of the cut in inches by the

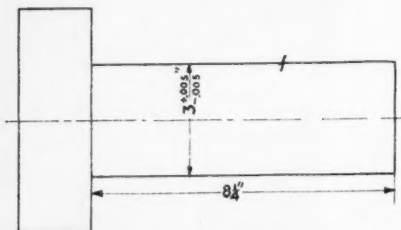


Fig. 2—Drawing of solid casting for which cutting time is to be determined.

diameter in inches by the proper constant selected from the chart on the horizontal lines designated by group numbers. To this is added a tool constant selected from the two bottom lines of the table.

The tool constant includes time for changing feeds, speeds, locking and unlocking the carriage, setting the cutting tool, setting cuts, gauging time, engaging and releasing feed, and starting and stopping the machine. The number of times time for these operations is allowed depends upon the number of cuts necessitated by the characteristics of the job.

Because of the high cutting speeds

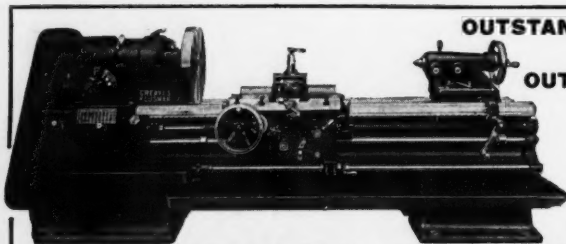
which can be used to machine non-ferrous alloys, the maximum cutting speed cannot be obtained on the smaller diameters. The minimum diameter to be used in computing cutting time is shown in the last two columns of the machining table.

Cutting time is quickly and easily obtained from this table. Assume that the solid casting shown by Fig. 2 is to be machined in accordance with the drawing at the 3 in. diameter section. The job may be held between centers and will be classed as strong. The fine finish is called for. The tolerances come within the second classification. The material is common brass which is grouped in Group 2. For these conditions a constant of .0034 is selected from the table for machining. The tool constant is .0422. The tool turning time is therefore

$$8.25 \times 3 \times .0034 + .0422 = .1264 \text{ hour.}$$

Similar tables may be compiled for grooving, parting, drilling, boring, reaming, threading, and so on. It requires a good deal of work to compile the charts, but once they are available, the computing of cutting time may be done in a few seconds. The values obtained are accurate, and one methods engineer is able to establish many time values each day.

Formulas that are accurate and



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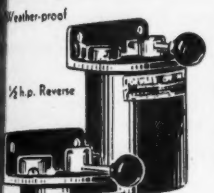
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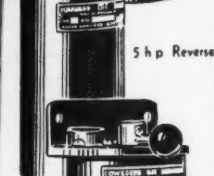
DRUM CONTROLLERS

TWO-SPEED: FOUR-SPEED: AND REVERSING

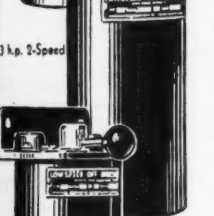
IMPROVED



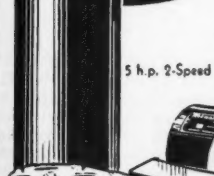
1/2 h.p. Reverse



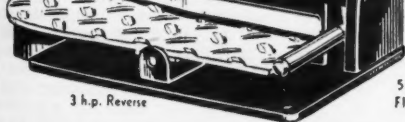
5 h.p. Reverse



3 h.p. 2-Speed



5 h.p. 2-Speed



3 h.p. Reverse

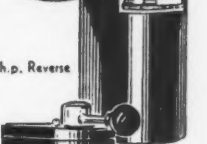
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ECONOMICAL:
MODERN: FINE
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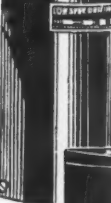
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styles.....for various Mounting and
Switching arrangements: many types
are now standard equipment on new
machines. We also furnish Special
controllers. (Send for new Catalog 36)



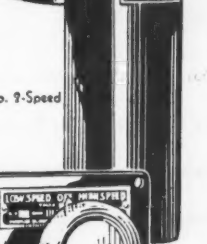
1/2 h.p. Reverse



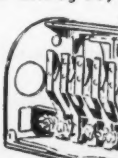
5 h.p. Reverse



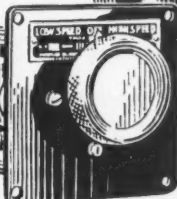
3 h.p. 2-Speed



5 h.p. 2-Speed

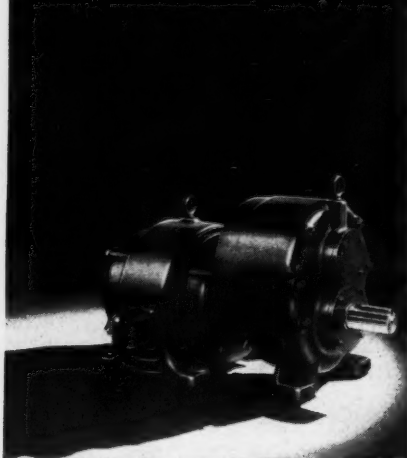


5 h.p. 2-Speed
Flange mounted



FURNAS ELECTRIC COMPANY
WEST ALLIS — WISCONSIN

MASTER is still first



More than ten years ago Master pioneered
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Each year since that time more Geared Head
Motors have borne the Master nameplate
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THE MASTER ELECTRIC COMPANY
DAYTON OHIO U S A

easy to apply can be compiled upon practically any class of work. In fact, on certain work of a miscellaneous or varied nature, such as store room work, it is impossible to establish time values by individual time study, and formulas which consider and allow for all of the variables which surround the work are a necessity. Time values are being set daily from formulas covering the following lines of work:

- All kinds of machine work.
- Bench fitting and assembling.
- All foundry operations.
- Arc welding.
- Drop forging.
- Painting.
- Window washing and janitor work.
- Maintenance and repair work.
- Tool making.
- Inspecting.
- Pipe fitting.
- Clerical and office work.
- Printing and type-setting.
- Packing and shipment.

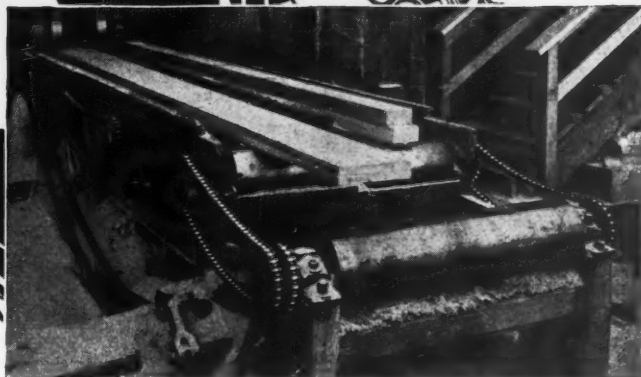
In the final analysis, it may be said that formulas permit quick, accurate, and consistent establishing of time values, and make possible the economical application of incentives to small quantity or jobbing work.

METHODS FOR THE FABRICATION OF LUKENS NICKEL-CLAD STEEL

This 12-page brochure, indicated as bulletin T-4, includes all the data that has been accumulated over the past five years on approved methods of fabricating Lukens Nickel-Clad Steel. In consecutive order the booklet takes up the subjects of physical properties, cold working, annealing for cold pressing, heating for hot working, surface cleaning, joining, metallic arc welding, types of joints, carbon arc welding, acetylene welding, atomic hydrogen welding, position welding, metallic arc welding, carbon arc welding, acetylene and atomic hydrogen welding, peening welds, forge welding, riveted joints, design, and applications. Copy free on application to Lukens Steel Company, Coatesville, Pa.



use **ROLLER
CHAIN**
here



UNFAVORABLE OPERATING CONDITIONS only serve to emphasize the advantages of Baldwin-Duckworth Roller Chains.

The drives here illustrated, for example, are almost buried in sawdust and waste, yet they convey lumber away from the saw month after month with unimpaired efficiency and without special attention.

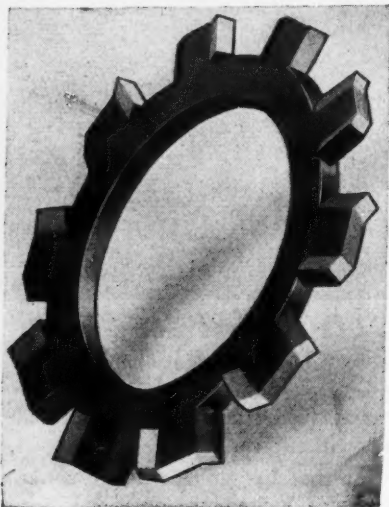
If there is a conveyor job in your plant that has to face severe conditions of any sort you will find Baldwin-Duckworth precision machined Roller Chain and Baldwin Accurate Cut Sprockets will give you smooth and uninterrupted operation. Our engineers will advise—free—on proper selection and installation. **BALDWIN-DUCKWORTH CHAIN CORPORATION, SPRINGFIELD, MASS.**

BALDWIN—DUCKWORTH

Lock Nut Designs

PUBLICATION of an article under the above title in the February issue of this magazine has brought forth responses from readers in the way of additional nut-locking devices. These will be described in later issues, but this month we present a popular device known as the "Everlock" Washer, made by Thompson-Bremer & Co., 1640-E West Austin Ave., Chicago, Ill.

The Everlock Washer has a number of projecting teeth so formed that the washer not only acts as a spring when the nut is tightened down, but each tooth is formed so that one edge will be forced into the work and the other into the bottom face of the nut, thus locking it. The



"Everlock" Washer

washer is made of a special steel which gives it the necessary "spring" to produce the desired result, and will spring back to shape after being released, thus making it possible to use the washer many times over.

The nut can be loosened by the use



Before setting down



After setting down

of a wrench, although the bottom of the nut may be sheared, but it will be practically impossible for it to work loose.

FOOTE SPEED REDUCERS. An 88-page catalog presenting the Brad Foote line of speed reducers is now being issued by Foote Gear Works, Inc., 180 S. Cicero Ave., Cicero, Ill. The catalog illustrates and describes flexible couplings, cut gears of all kinds, power transmission equipment and sprockets, and gives examples of applications of such equipment. Complete data is given for each unit, including ratios, motor specifications, and price list. The units are illustrated with photographs and line drawings. Dimensions are given in inches, together with weights and motor frame numbers. Copy free upon request.

"MICHIGAN" GEAR FINISHING PROCESS. The key to accuracy and lower costs in the matter of gear production is contained in a 4-page folder which explains in detail the "Michigan" finishing process. A copy of the folder can be had upon request to Michigan Tool Company, 7171 E. McNichols Rd., Detroit, Michigan.

RELAYS, timing devices, thermostats, pots and ladders, resistors, thermal relays, insulators, and similar equipment are described and illustrated in a 28-page catalog that has just been issued by Struthers Dunn Inc., 139 N. Juniper St., Philadelphia, Pa. Copy free upon application to this firm.

**Here's
REAL Tapping
Production**

**1450 PIECES PER HOUR!
DOUBLE THE OLD OUTPUT!**

New speed. New precision. New production volume. Notice the quick-acting fixture. No clamps or hold-downs here. Notice the very thin wall of the casting. Yet the rigid Haskins spindle maintains a class 3 fit without difficulty.

The exclusive features of the Haskins Method are illustrated and explained in our new booklet, "High Speed Precision Tapping." Write for your copy. It's free. It will pay you to read it. R. G. Haskins Company, 4667 West Fulton St., Chicago.

One of a series of case histories showing tough jobs made easy by The Haskins Tapping Method.

Material.....Zinc Base Die Casting
Size of Thread..... $\frac{3}{8}$ " — 24
Length of Thread..... $\frac{3}{4}$ "
R.P.M. Threading "In".....1080
R.P.M. Threading "Out".....2160
Production....1450 Pieces per Hour



THE HASKINS METHOD

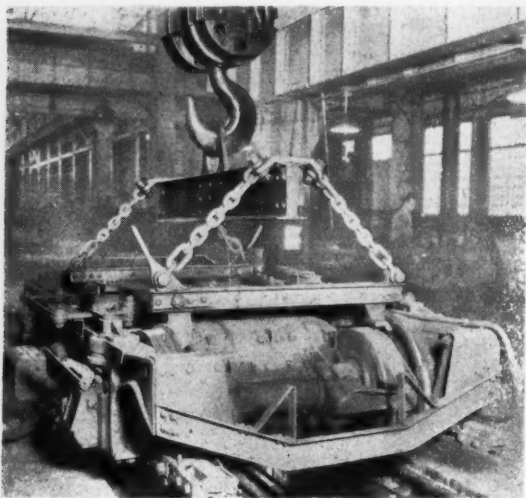
Ideas from Readers

This department is a clearing house for ideas . . . If there is a "kink" or short cut in use in your shop, send in a description of it . . . Each one published will be paid for.

Cradle for Transporting Electric Car Trucks

By S. J. RAETZ

THE illustration shows the equipment used to lift and transport subway car trucks at the maintenance shops of the Independent Subway



Lifting a subway car truck at the Independent Shops in New York City Subway System

System, New York City. This equipment, generally known as a "cradle", is simple to manipulate and safe.

The cradle consists primarily of a section of 8-inch I-beam, from each end of which is suspended a much lighter section carrying hooks for grappling the wheels, the whole being suspended from the hook of the

traveling crane by means of an eye-piece riveted to the I-beam at the middle as shown.

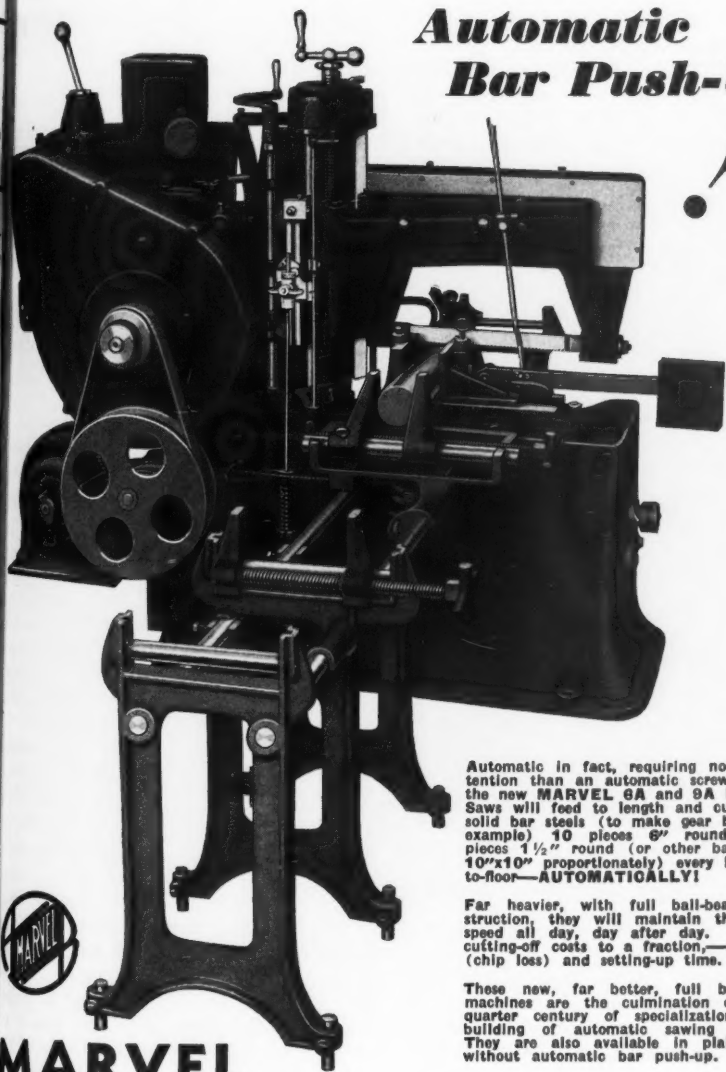
The light sections carrying the hooks are attached to the main I-beam by means of short, heavy lengths of chain, one of which, instead of being attached directly to the light I-beam, is attached to one of the hooks. The hook, in turn, is equipped with a handle and is pivoted to the beam so that it can be swung to clear the wheel until the solid hook has been located under the rim of the opposite wheel, then the pivoted hook is swung to place under the rim of the wheel with which it is in contact. With both ends of the cradle in place, the signal is given to pick it up. It is obvious that the greater the load and the harder the pull, the more firmly the hooks are held in position and the surer the lock. There are no slings to make, no danger of slipping, and the cradle can be hooked in position on the car truck without difficulty.

Automatic Reversing Mechanism

By JOHN A. HONEGGER

IN AN automatic cable-winding machine recently designed by the writer it was found necessary to in-

Automatic Bar Push-Up



Automatic in fact, requiring no more attention than an automatic screw machine, the new MARVEL 6A and 9A Production Saws will feed to length and cut-off from solid bar steels (to make gear blanks, for example) 10 pieces 6" round or 160 pieces 1½" round (or other bar sizes to 10"x10" proportionately) every hour floor-to-floor—AUTOMATICALLY!

Far heavier, with full ball-bearing construction, they will maintain this terrific speed all day, day after day. They cut cutting-off costs to a fraction,—save stock (chip loss) and setting-up time.

These new, far better, full ball-bearing machines are the culmination of over a quarter century of specialization in the building of automatic sawing machines. They are also available in plain models without automatic bar push-up.

MARVEL

Automatic-Production

HACK SAW MACHINES

No. 6A and 9A from the MARVEL Line—that comprises saws for every metal-cutting need.

Write for Bulletin 600-A

ARMSTRONG-BLUM MFG. CO.

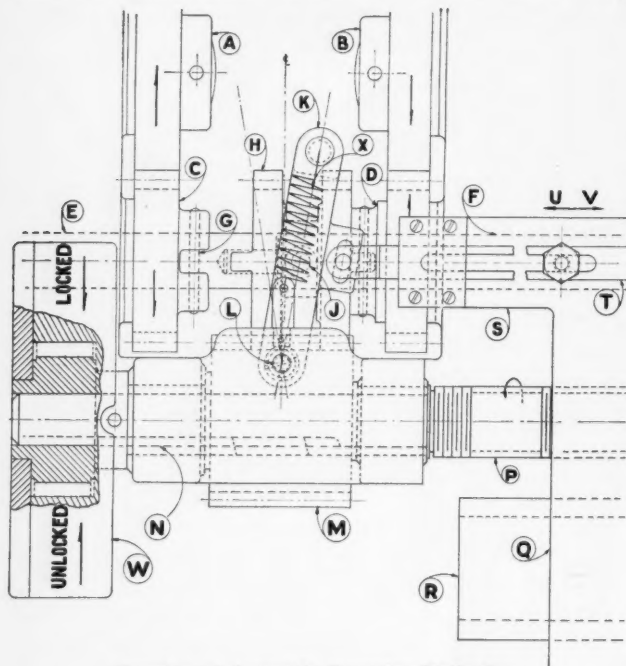
"The Hack Saw People"

345 N. FRANCISCO AVE.

CHICAGO, U. S. A.

corporate an automatic reversing mechanism to allow reversal of the winding guide at any point from zero to the maximum, so that reels of various widths could be wound on the same machine. The various feed pitches required for the different windings were obtained by means of

ran freely upon the shafts E and F. The spool was shifted from side to side by the pins J in form K, which was pivoted at L. It should be noted that spool H remained in constant mesh with the gear M, which gear was keyed to the shaft N. This shaft was made integral with the lead



Drawing of Automatic Reversing Mechanism

a series of pick-off gears not shown in the illustration.

The input to the mechanism was applied through the gears A and B, which rotated in opposite directions. These gears mated with gears C and D, which were pinned to the shafts E and F. Clutch slots were milled into the ends of the shafts. Only one slot is shown in the drawing, but the clutches were of the usual multi-tooth type.

A combination gear and spool H

screw P, which actuated the winding guide casting Q located on the ways U V. Integral with the guide Q was the T-section S which provided sliding ways for the slotted rod T. The rod T was connected to the fork K, as shown.

Upon the end of the shaft N was pinned the free-wheeling flywheel W. This flywheel was designed so that it would lock with the shaft in one direction, but would lock in the opposite direction and run free. Upon the opposite end

of the shaft a similar free-wheeling flywheel was located, but arranged to lock in the opposite direction from the flywheel W. The spring X kept the clutch in mesh with the gears C or D until acted upon by the fork K.

In operation, the spool H in mesh with the gear D would cause the lead screw P to revolve in the same direction as the spindle of a lathe, as shown. The operation of the lead screw would move the guide Q in the direction indicated by the arrow U

WHAT SHOP MEN ARE SAYING *about*

TRADE
VASCO
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CROCAR
Die Steel

VANADIUM
ALLOYS
STEEL CO.
LATROBE, PA.



**MACHINE TOOL
BUILDER**

says that Crocar gives better results as a work-rest for centerless grinder than anything they have ever tried.



**CAN
MANUFACTURER**

Crocar dies for blanking and forming tops and bottoms of sanitary cans produced over 300,000 blanks before re-grinding was necessary.



**BEARING
MANUFACTURER**

Crocar Plug gage for inner race of ball bearings gaged over 9000 holes which is 1500 better than next best steel used by them.

VANADIUM-ALLOYS STEEL COMPANY

LATROBE, PENNA.



PRETTY poor economy to make expert hands struggle with heavy loads! It tires workmen—takes too long—costs too much—slows up production of men and machines. The P&H Zip-Lift brings you a new and better method for floor-to-floor handling—turns waste time into profit. Because it's so much easier to install, to operate, to own—the Zip-Lift can save money at many points around your shop. Ask us for "spot handling" suggestions.



HARNISCHFEGER CORPORATION
ESTABLISHED 1894
4535 W. National Avenue • Milwaukee, Wis.

Zip-LIFT

**STOPS WASTE
WITH "SPOT HANDLING"**

until it contacted the shoulder Z of the rod T. The guide would then push the fork K, forcing the spool H to move out of the slot G until it had become entirely disengaged. At this point the leadscrew P would normally stop revolving.

However, the energy stored up in the free-wheeling flywheel would continue to revolve the leadscrew until the fork K had passed through the high side of the arc and a little beyond, at which point the spring I would snap the spool H over against the face of the gear C and into the slot. At this instant the leadscrew would reverse and the opposite flywheel would gather momentum for the reversal process.

After a trial run it was found necessary to make the bearing surfaces in the free-wheeling flywheel a friction fit, so as to "brake" the free-wheeling flywheel slightly and bring it down to a speed below the running speed of the shaft; thus when again brought into operation it could immediately pick up in the proper direction.

Recessing Tool for Drill Press

BY ALBERT A. DOWD

IN order to cut production time and eliminate a certain amount of handling, it became necessary to develop a tool with which a recessing operation could be performed in the drill press. The tool shown in the cross section drawing herewith was the result.

The work, indicated at A, is a cast iron hub with a flat base. The hole C is drilled, reamed, and counter-bored; the small hole D is drilled, and the recess E is cut. The exact form of the recess is of relative unimportance because it is used only as

WINNING

success in all fields

In the opening announcements of the NEW Nicholson, Black Diamond and McCaffrey Files we urged file users to make the test of actual use in their own plants.

**The Reaction Was Immediate
FROM ALL OVER THE COUNTRY
Reports Are Pouring In Unqualified Approval
of the
NEW FILES**



**FROM AN INTERNATIONALLY
KNOWN MACHINE
MANUFACTURER**

"These New Files have exceptionally sharp teeth which give lasting service. In fact they are the toughest files we have ever tried out."

PRaise FROM VIRGINIA

In a nationally known machine works, NEW Files were given comparative tests—called definitely superior.



**DROP FORGING PLANT ORDERS
NEW FILES:**

A large New York concern tried out 12 Flat Bastard Files, praised them highly, then placed orders.

IN THE GREEN MOUNTAIN STATE

Head machinist in "Roe shop" enthusiastic about the Flat Bastard Files, especially for snagging iron castings.

Make the final tests in your plants. See for yourself how the NEW Files remove more metal—cut faster—last longer. At hardware wholesalers and mill supply dealers. Nicholson File Company, Providence, R. I., U. S. A.

Available in
NICHOLSON, BLACK DIAMOND, McCAFFREY Brands

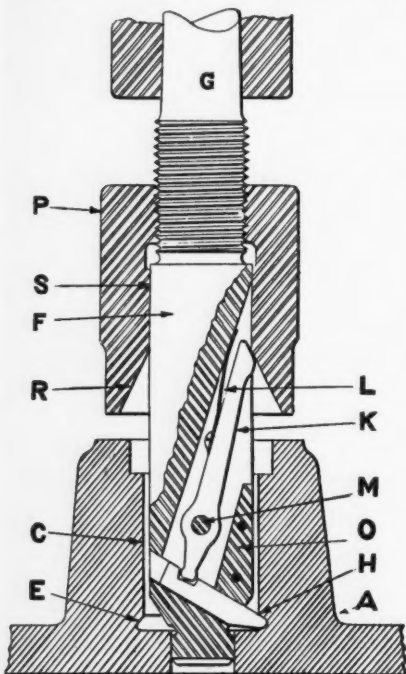
A FILE FOR EVERY PURPOSE

NICHOLSON
U.S.A.
MADE IN U.S.A.

NEW METHOD OF
MANUFACTURE AND
TOOTH CONSTRUCTION BY
PATENTS PENDING

retaining groove into which a soft bushing is expanded.

Owing to the small size of the work and the limited amount of space available, there was not much opportunity to make tools with adjusting mechanisms, but as the speed was slow and no scale was encountered, this was not a great drawback. The



Cross-Section Drawing of Recessing Tool for Drilling Machine

design of the tool is both simple and sturdy, consisting primarily of a shank F the upper part of which is tapered at G to fit the spindle of the machine. The lower end of the holder is piloted to provide the necessary rigidity.

To provide for the operation of the recessing lever K, a slot is cut in the shank at a 30-degree angle from the

center line, and across the bottom of this slot a hole is drilled at a 60-degree angle. The recessing lever K is pinned in position in the slot by pivot M, and a filler block O is chored in the slot to provide rigidity. The lower end of the recessing lever projects into a slot across the top side of the toolbit which is ground on all sides to fit the cross-hole in the shank. The toolbit H is of the correct length so that, when the upper end of the operating lever K projects from the side of the point of the toolbit is under the surface of the shank. The spring S is provided to hold the upper end of the operating lever out of the slot and thus keep the toolbit in until it reaches the correct position for recessing.

To provide for feeding the tool into the work, the sleeve P was made and threaded onto the shank with a 16-pitch left-hand thread. The inner end of the sleeve is ground to a running fit on the shank, and the outside is knurled so that it can easily be grasped by the operator. The lower end of the hole in the sleeve is ground to a taper is shown at R.

To operate, the spindle is lowered until the shank has reached the proper depth in the work. Then, with the spindle revolving at a slow rate of speed, the operator alternately grasps the knurled sleeve and releases it, holding it for one or two seconds each time. By holding the sleeve while the spindle is revolving, it causes the sleeve to be threaded downward, forcing the upper end of the operating lever K into the slot and thus feeding the toolbit H downward. In this manner the recess cut to the desired depth. Then, by grasping the sleeve while the spindle is reversed, the toolbit is withdrawn into the shank until the shank can be removed from the hole.

KNURLED

UNBRAKO

Socket Head Cap Screw



Every mechanic, when driving screws, will invariably use his fingers as much as possible, because they are much handier than any wrench and save time.

With the Knurled "Unbrako" he can drive much faster, as his fingers actually become geared to the Knurled Head so they can't slip.

Smooth Head Screws, hard to get hold of are much slower to drive.

The Knurled "Unbrako" is of exactly the same high quality as the smooth head "Unbrako",—

**BUT COSTS
NO MORE.**



U. S. & Foreign Pats. Pending

Order by Name—Specify:
The KNURLED "UNBRAKO"
FREE SAMPLES
STANDARD PRESSED STEEL CO.
Jenkintown, Pa.

Branch Offices and Warehouses

**DETROIT
NEW YORK**

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SAN FRANCISCO**

U. S. & Foreign Pats. Pending
Fingers become geared to
the knurled "Unbrako"
and therefore can't slip

Mechanism for Reciprocating a Shaft and Varying Its Point of Reversal

By J. E. FENNO

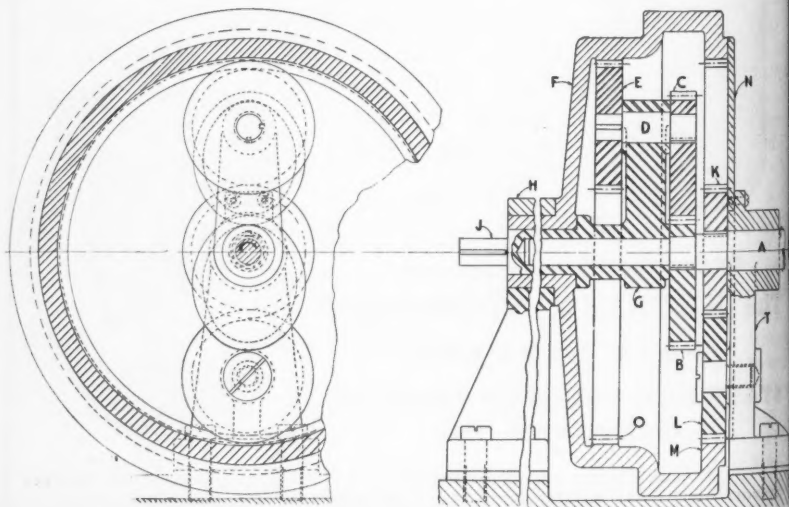
PLANETARY gearing which imparts a reciprocating movement to a shaft and varies uniformly each succeeding point of reversal is used for driving the agitator of a machine for mixing and bottling a certain household chemical. One advantage worthy of note in connection with this type of gearing is the absence of shock when reversing and the remarkable quietness with which it operates. Consequently, there is little wear in operation.

The construction of this gear unit is simple and is relatively inexpensive. Its chief parts consist of drive shaft A upon which is keyed an elliptical gear B meshing with a duplicate gear C keyed on the short shaft D. On the other end of shaft D is

keyed the gear E, which meshes with the internal teeth O cut all around the inside of the drum F.

Shaft D is free to turn in the bearing G, and this arm in turn is free to turn on the shaft A and in the bearing H on the sleeve on the drum. This drum is supported by means of the sleeve in the long bearing H secured to the machine. To extension shaft J, arm G is keyed the driven member which, as already mentioned, is the mixing machine agitator.

Gear K is also keyed to shaft A and meshes with idler gear L on the stationary bracket T fastened to the machine. Idler gear L also meshes with the internal ring gear M and has the same pitch diameter as the teeth O. Incidentally, the diametral pitch of all the teeth in the unit is the same for all gears. The cover is a flat circular plate secured to bracket T by screws. This cover excludes dust, etc., from the gears and bearings within the drum.



Planetary Gearing with Elliptical Gears for Reciprocating a Shaft and Varying Its Point of Reversal

FILES WITH METAL SAW TEETH

"A Revolutionary Idea in File Making"

Announced and first put on the market less than two years ago.

**Instantly recognized
by File Buyers and
Users Alike by a
brilliant and distinctive
marking**

RED TANG

*(Color on the tang Trade Mark
Reg. U. S. Pat. Office)*

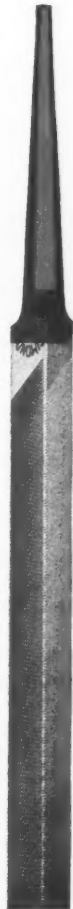
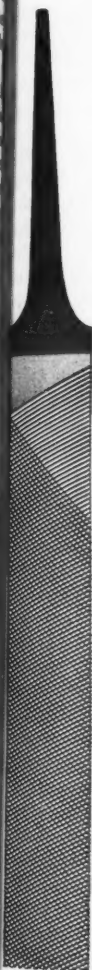
Today their greater cutting efficiency and longer wearing qualities have won general recognition in mills, shops, and factories for this major improvement in File manufacture.

*Use Red Tang Files. Ask
Your Dealer For them.*

**SIMONDS
SAW AND STEEL CO.**

FITCHBURG, MASS.

Established 1832



The magnitude of the reciprocating movement depends upon the position of the foci of the elliptical gears. In this instance, the foci is located close to the pitch curve of the gears, giving a relatively large angular reciprocating movement to the extension shaft J.

In describing the action of the gearing, the writer believes that the action will be more clearly understood by first assuming that gears K, B, C and E have the same pitch diameter; and that gears B and C are concentric instead of elliptical. If this were so and shaft A were given one turn, gear K, through idler L, would rotate the drum F at constant speed. Arm G, however, would remain stationary because the gear E would also be rotated the same number of teeth as gear K; hence, the pitch line velocity of gear E would be the same as that of teeth O. Consequently, gear E would simply roll in teeth O without changing the angular position of arm G.

Now to return to actual conditions, let us replace the concentric gears B and C just assumed by the elliptical gear shown. Since gear B rotates at a constant speed, the angular velocity of gear C will increase during the first half revolution from the position shown and decrease during the remaining half. During each half revolution, there is one point of tooth contact at which a one-to-one gear ratio is obtained. At this point, arm G is momentarily stationary as in the case when gears B and C were assumed to be concentric. This point occurs somewhere between the maximum and minimum velocity ratios of these gears. Hence, the angular velocity of gear C is first accelerated and then retarded after one point is reached; and after the other point is reached, the angular velocity of this gear is first retarded and then is

accelerated.

In the former case, the pitch line velocity transmitted to gear E is greater than that of teeth O; hence arm G with extension shaft J will rotate in a counter-clockwise direction or in the same direction as shaft A. In the latter case however, the pitch line velocity of gear E is less than that of O, so that arm G and shaft J reverse their movement and rotate in a clockwise direction. These movements are repeated successively so that a constant reciprocation of arm G and the extension shaft J results.

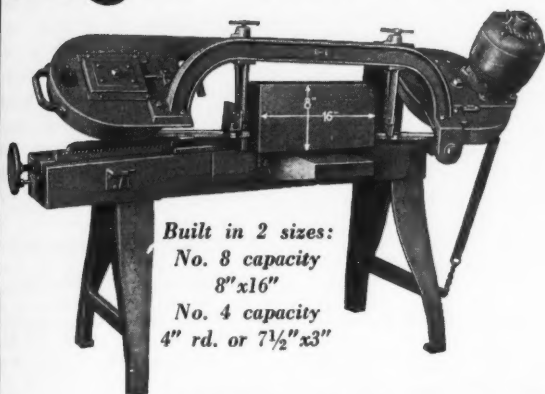
The desired change of the points of reversal is obtained by varying the number of teeth in either of the gears K and E. In determining the positions and the changes in the points of reversal, the work is greatly facilitated by laying out the various relative positions of the arm G and the elliptical gears during one complete cycle. In this way trial sizes of gears K and E can be selected until the correct sizes are found that correspond with the desired reciprocating movement.

Tap or Die Holder for Lathe Tailstock

By J. E. MOORE

THE tool illustrated was designed to hold either a die of the small circular variety or a wrench in which a tap can be gripped, and is intended for use in the tailstock of an engine lathe. The tool consists primarily of the shaft C, upon the end of which is located the recessed section B and to which is attached the handwheel A. The shaft C is free to slide and rotate in the Morse tapered shaft D. The holes H are provided in order to allow the shavings to escape, and

High Efficiency--



Built in 2 sizes:

No. 8 capacity
8" x 16"

No. 4 capacity
4" rd. or 7 1/2" x 3"

**LOWER
METAL
CUTTING
COSTS**

with the

WELLS BAND SAW

***Will Cut All Kinds of Tubing
Cuts all shapes--at any angle***

Using the band saw principle of continuous cutting, excessive friction is eliminated and the machine can be operated at high speed without the use of coolant.

Invaluable for tool room or production work, this simple sturdy machine will enable you to reduce metal cutting costs by making 50% more cuts in the same time with a corresponding reduction in labor cost per cut.

Equipped with a convenient two-piece vise, the material can be quickly adjusted and cut at any angle. The Wells Band Saw will handle any metal, thick or thin, sheet, rod or tubing up to the limits of its generous capacity. Rigid ball bearing saw guides insure accuracy. Learn more about the advantages of the Wells Band Saw.

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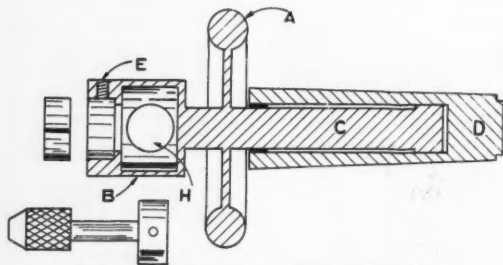
THE WELLS MANUFACTURING CORP.

315 SEVENTH AVE., THREE RIVERS, MICHIGAN

Representative in England: Gaston E. Marbaix, Ltd., Vincent House, Vincent House Square, London.
New York and Connecticut Representative: Wm. Halpern & Co., 53 Park Place, New York City.

the small setscrew E is used to lock the tool in position.

The hole at the front end of the tool is bored just large enough to



Tap or Die Holder for Lathe Tailstock

take a small die. A steel piece of the same size as a die can be made and a square aperture cut into the center of it so that the square end of a tap-shank can be inserted, making the tool adaptable for holding taps.

The shank D is inserted into the

center hole in the tailstock, then the handwheel is gripped and prevented from revolving while the machine operates at a slow rate of speed until

the tap or die has cut the desired length of thread. At this point the wheel is released and allowed to revolve with the work until the lathe spindle has been reversed. For certain kinds of work the tool is very handy, as well as inexpensive.

SILENT STEEL GEAR FOLDER. The John Waldron Corporation, Dept. M., New Brunswick, N. J., manufacturers of the Waldron Silent Steel Gear, has issued a folder which points out the importance of the elements of steel and silence in gear operation. It likewise refers to the Waldron Silent Steel Gear Blanks which are furnished in various sizes and fixed face widths. A copy of the bulletin is available to any interested executive.



A handy copy of the Bunting catalog will save time, trouble and expense almost every day. It describes over 600 different sizes of completely machined and finished Bronze Bearings, 121 sizes of Machined and Centered Cored and Solid Bronze Bars, and many other bronze products usually made to order but which you can now obtain instantly at any time from the stocks described in this catalog. Write for your copy.

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ARE you taking full advantage of abrasive wheels in your cut-off operations? And are you obtaining the very lowest costs by using Norton Wheels? You'll like the way they eat through metals or non-metals, solid bars, tubing and other shapes.

There's a complete line of Norton Cut-off Wheels — from husky brutes for slashing through stone to paper-thin disks for slitting pen points. There are Norton field engineers who specialize on cut-off work—who can help you on your problems. Their experience is available for the asking.

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Over the Editor's Desk

Incentives

WE are particularly pleased with the manner in which Mr. Maynard's articles on "Methods Engineering" have been received by our readers, as evidenced by the number of requests we have had for extra copies of these articles. The study and application of correct methods of working is a valuable branch of engineering, and as such is being applied in a constantly-widening field. Just as long as our social and economic system provides an incentive for a manufacturer to turn out a good product and to merchandise it in competition with other manufacturers, just so long is it going to be necessary to provide an incentive for the individual worker to do his best in matters of both quality and quantity.

The fact that the application of the principles under discussion eliminates all unnecessary movements and reduces the time and effort required to the minimum does not necessarily mean that the worker is being driven to his utmost; unnecessary labor is waste, and the elimination of unnecessary movements is simply the elimination of waste. There are many tasks which, given a dozen different workmen, would be accomplished by a dozen different methods, no two of which would require the same amount of effort and time. Obviously, one of the methods is the best and the others should be discarded. And, nine times out of ten, an analysis of the job by a trained engineer would reveal extra movements which could be eliminated and the waste further reduced.

There is no excuse for waste!

Evolution

According to reports from recent visitors to Russia, the system of mass education that was inaugurated after the revolution is having its effect. The Russian people are adopting the modern styles in wearing apparel, and the Russian newspapers are carrying large quantities of advertising which is intended to create a market for modern accessories to living. The demand thus created will necessitate factories of all kinds, which, in turn, will call for machinery and equipment.

However grueling the conditions may be under which the Russian people are existing at the present time, nation-wide education is a tool under which these conditions will sooner or later be rectified.

Electric Current

The amount of electrical current consumed in 1935 exceeded by 7 per cent the amount used in 1934, and it appears that the increase in 1936 over 1935 will be even greater. This constant increase in the use of electricity means an increase in all sorts of industrial operations for which current is necessary, as well as the increase in manufacturing necessitated by the increased use of electrical appliances and machines.

There are approximately 65,000,000 electrical household appliances in use in the homes of America, yet 50 years ago it was the general consensus of opinion that Edison was crack-brained. Within these 50 years we have come to recognize the fact that electricity is the power that actuates all creation, and now we think of electricity first in connection with any task where power is required. That should be a good lesson in being open-minded.

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YOU WANT ...
*Alundum Abrasive***



FINISH is essential in the polishing of automobile fenders — there can be no imperfections in their surface — no die marks to show through the enamel. Because Alundum Abrasive gives just the desired finish and does it quickly and economically too, it is the popular choice throughout the automotive industry.

Of course, there are definite reasons why Alundum Abrasive does such a good job — and three of them are:

1. **Uniform Size** — special Norton sizing methods insure grains of exceptional uniformity — no over-size grains to scratch or mar the surface.
2. **Strong Shape** — special Norton crushing and screening processes give a strong, blocky shaped grain (designated as E-1) that stands up and gives long life.
3. **High Capillarity** — special Norton treatments give a grain of high capillarity. It sticks to the wheel head in spite of the severe treatment it receives in fender polishing.

Norton engineers who have had years of practical polishing experience will be glad to study your polishing jobs — to make sure that you get just the right abrasive in size, shape and treatment that you require.

Norton Company
Worcester, Mass.

G-30

NORTON ABRASIVES

New Shop Equipment

Special Fellows Gear Shaper for Using Gap-Type Cutters

The Fellows Gear Shaper Company, Springfield, Vermont, has placed on the market a special Gear Shaper, shown in Fig. 1, which is arranged especially to

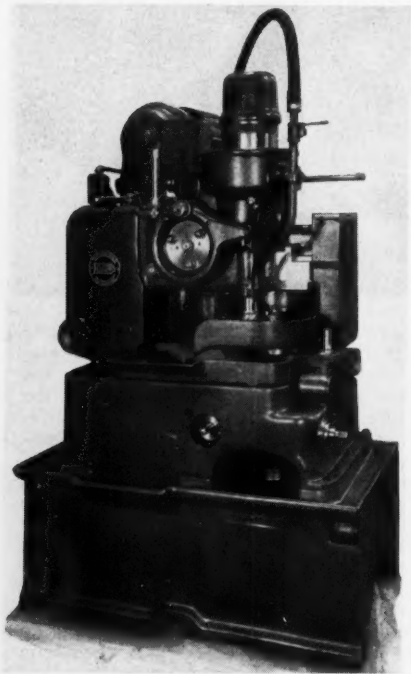


Fig. 1—Special Fellows Gear Shaper arranged for using gap-type roughing and finishing Gear Shaper Cutters.

make use of a new cutter known as the "gap-type". This type cutter is adapted to the rough and finish cutting of external spur and helical gears in one operation. The teeth on the circumference of the cutter are interrupted by one or more gaps, depending on the diameter and character of the work. The gap permits loading and unloading of

the work without withdrawing the cutter from the work. The machine is arranged with motor drive and automatic electrical control to stop the machine when the gap in the cutter is located in the most convenient position to remove and insert the work.

This gap-type cutter differs from the regular Gear Shaper cutter in the following respects: (1) a single cutter is used for both roughing and finishing the cutting being done by separate sets of teeth; (2) the cutter is made with a multiple of the number of teeth on the work; (3) the cutter is held in fixed position during the roughing and finishing cuts; and (4) the cutter is rotated into depth, instead of being rotated in radially.

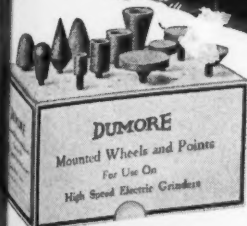
The gap-type cutter is made with several arrangements of the cutting teeth. The cutter shown in Fig. 2, which is used for cutting a 16-tooth helical gear, is made with two sets of teeth: one for roughing, the other for finishing. The roughing teeth are made short and thinner than the finishing teeth. In this case the work makes two revolutions to one revolution of the cutter and, of course, completes the gear in one operation. Cutters are also made with more than one gap and with a variety of arrangements of the cutting teeth to meet requirements.

The machine differs from the regular Gear Shaper in that it is arranged with electrical control for timing the rotation of the cutter-spindle. Fig. 3 shows a close view of the timing mechanism with cover plate removed to expose the operating mechanism. It will be noted that the limit switch is geared to the upper worm-shaft and is driven by it. The ratio gears rotate the cams that operate the electrical control mechanism. One cam acts to stop the machine, the other sets up an electrical circuit preparatory to the operation of the "stop" cam.

The driving gears must have a direct relation to the number of gaps in the cutter. For a one-gap cutter the ratio is 2 to 1, and 1 to 1 for a two-gap cutter. This application of the Gear Shaper and Gear Shaper cutter has several important advantages, briefly summarized as follows:

1. Gears can be rough and finish

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The Dumore No. 8 Hand Grinder is usually called the "handiest tool in the shop"—it can be put to so many time and money saving uses. It is unequalled for finishing small openings, radii, and irregular shapes in all types of dies and molds . . . for correcting inaccuracies in blanking dies . . . providing top rake of a forming tool . . . touching up taps and cutters . . . sharpening dinking, button and acorn dies . . . lapping small holes . . . etc. etc.

The Dumore No. 8 is a high speed grinder, light in weight but powerful. It has a 1/40 h.p. universal motor, dynamically balanced for smoothness. An effective ventilating system makes continuous duty possible—a positive filter prevents the entrance of harmful dust. It's the kind of a tool that once you own it, you wonder how you ever got along without it. Write for folder "Hand Grinding the Modern Way."

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- with the same cutter in one operation.
2. The removal of material is divided between roughing and finishing sets of teeth contained on the same cutter; thus one cutter fulfills two functions.
3. During the entire cutting operation—roughing and finishing—the position of the saddle remains unchanged, thus assuring positive control over size.
4. By the elimination of one handling operation and a decrease in the

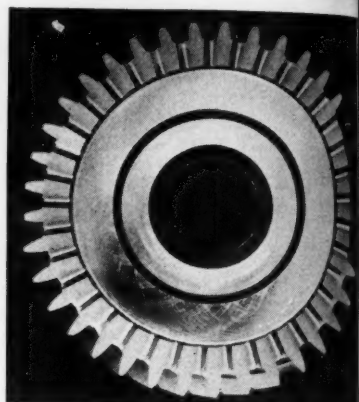


Fig. 2—Gap-type Gear Shaper cutters for roughing and finishing helical pinions in one operation.

cutting time, production is increased about one-third.

5. Total costs are reduced due to the saving in cutting time, handling, operating expense, etc.

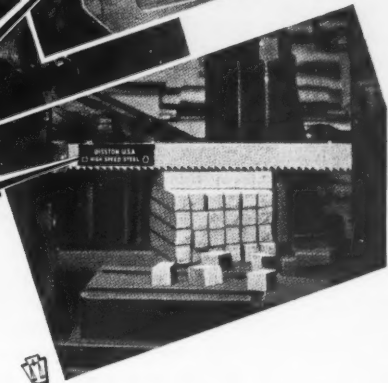
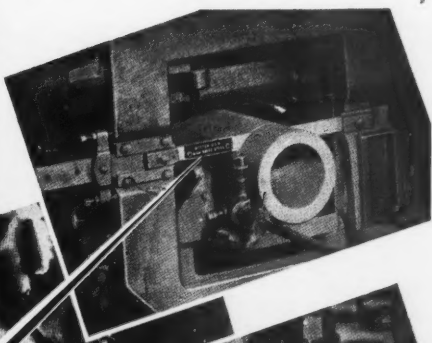
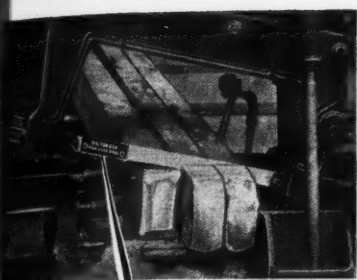
In some cases it is also possible to obtain greater accuracy. This is especially so in the cutting of small fine-pitch pinions, due to a better distribution of the cutting between various sets of cutting teeth.

The electrical equipment comprises a constant-speed motor; motor starter with thermal overload protection; interlocking contactors of the "make" and "break" type; push button control station; automatic stop for use with regular cutters; and cam-operated limit switch.

The application of this method of control does not in any way interfere with the use of regular cutters on the machine. When regular cutters are used, the limit switch is rendered in-

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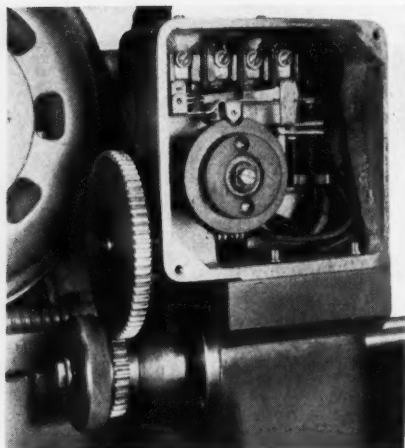


Fig. 3—Close view of timing mechanism control for use with gap-type cutters.

operative by removing the driving gear on the upper worm shaft and setting the automatic stop control to stop the machine. Maximum capacity is about

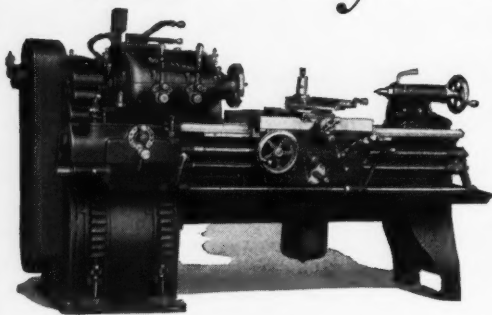
2½ inches pitch diameter, 6/8 diameter pitch.

Haskins No. 4 Heavy Duty Tapper

Because of the general acceptance of the principles involved in the Haskins Method of High Speed Tapping, as embodied in their No. 1 and No. 2 types of machines, the R. G. Haskins Company, 4667 W. Fulton St., Chicago, Ill., has added to its line of tappers another machine of larger capacity. Known as the Haskins No. 4 Heavy Duty Tapper, the machine is ideally suited for handling taps from ⅜-in. to ¾-in. in brass and from ⅝-in. to ¾-in. in steel, where the work consists of light-weight castings, forgings, stampings and screw machine products.

The construction of the tap head embodies all of the salient features of the lighter capacity machines, but is necessarily more rugged to conform to the heavier work for which it is intended. The head is driven by a specially designed 1 h. p. motor operating at 1725 r.p.m. through pulleys providing three tap speeds of 550, 750 and 1000 r.p.m. The reverse speed is double that of the tapping speed. The tap head mechanism, which is readily removable, is en-

an ACCURATE LATHE that *Stays* ACCURATE



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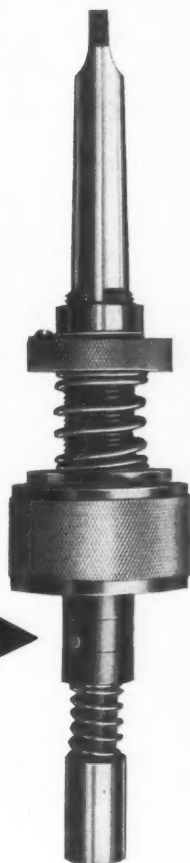
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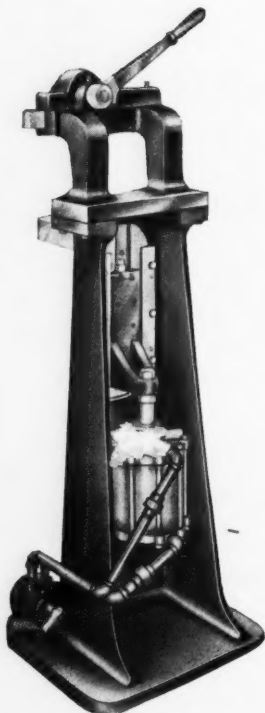
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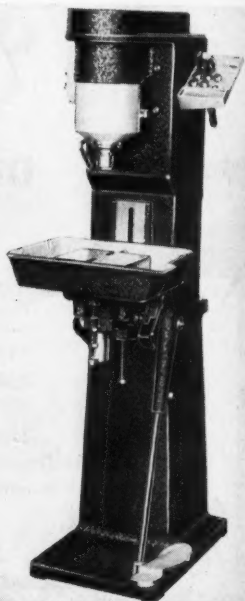
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HI-DUTY MARKING MACHINE**

This machine operates from your plant air line, and is one of numerous models built to produce fast, neat marking on metal parts. Hi-Duty marking machines may be had for practically any marking operation, and we will be glad to make recommendations upon receipt of your inquiries. Send prints or samples of parts to be marked, showing lettering and location, also state required production.

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tirely enclosed in a cast aluminum shell, sealing the gears, bearings and spindle shafts from dust and foreign matter.

The tap head is stationary and the work is presented to the tap by raising



Haskins No. 4 Heavy Duty Tapper

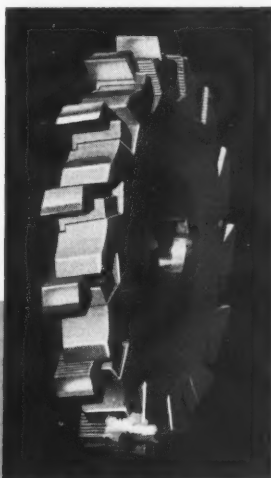
the table, which is operated by means of a rack and segment, through gears, by a forward movement of the foot pedal. Two cushion springs absorb any excessive or irregular pressure on the foot pedal, thus maintaining a constant feed.

Unusual sensitivity of operation for a machine of this size is secured through the retention of the principles of design incorporated in the tap heads of the No. 1 and No. 2 types of machines, and through the exclusive features pertaining to the table lifting mechanism just described.

Positive lubrication is afforded by a rotary pump, the amount of flow being controlled by a hand operated valve. The oil sump has a capacity of three and one-half gallons of tap lubricant. The tap spindle is so designed that a standard "Acorn" die and holder may be installed instead of the collet chuck to permit of external threading.

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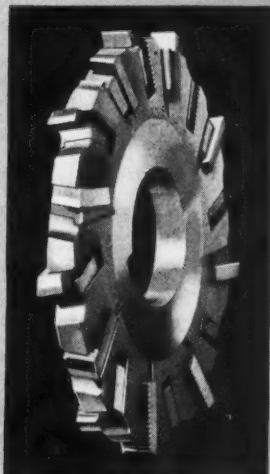
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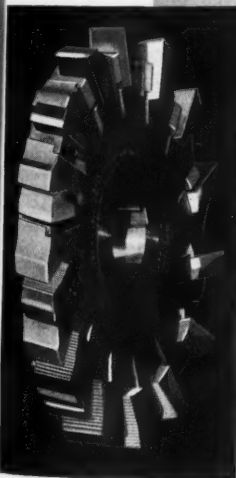
Have Ingersoll engineer your cutting tools, special or standard. Write for tool charts and catalog.

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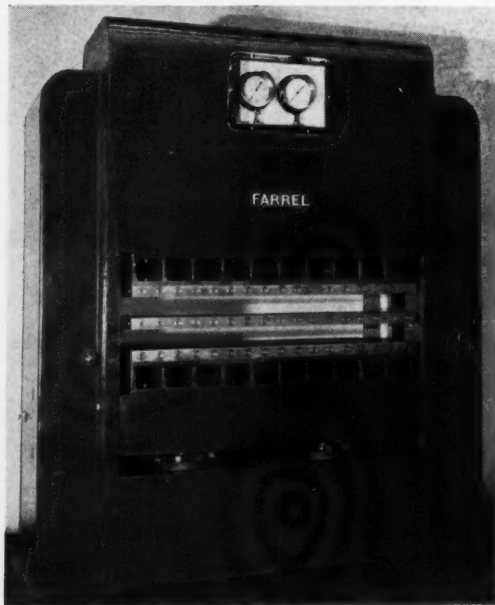
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Farrel-Birmingham 60x30-Inch Two-Platen Hydraulic Press

A new design of hydraulic press with a self-contained hydraulic power unit using oil as the fluid medium is announced by the Farrel-Birmingham Company, Inc., Ansonia, Conn. Made especially for plastics and rubber moulding operations, this press may be readily



Farrel-Birmingham 60x30-In. Two-Platen Hydraulic Press

adapted for other work. It is of 140 tons capacity and has platens 60 in. wide and 30 in. deep. Two 8-in. diameter rams working in the cylinders, which are integral with the bottom crosshead casting, provide a pressure of 150 lbs. per sq. in. over the platen area.

The top crosshead, which also serves as an oil reservoir, is provided with a steel bedplate on the top surface, on which is mounted the variable displacement pump with its driving motor. In a recess in the face of the top crosshead are mounted steam and hydraulic gauges, behind a protective shatter-proof glass. The gauge enclosure has a white enameled interior and the gauges are made easily visible to the press

operator by indirect lighting. Rolled steel side slabs are incorporated in the press as tension members between the top and bottom crossheads, instead of the conventional tie rods. The side slabs are machined to receive corresponding lugs on the top and bottom crossheads and adjustment is provided by means of patented adjustable tapered keys.

Between the top and bottom steam platens and the top and moving crossheads, ventilated grids are placed to lessen heat transfer between the platens and the crosshead. The steam platens are provided with steam connections and the tension slabs have proper clearance for the moving piping.

To operate the press but one valve is used, the simple opening or closing of which opens or closes the press. Maximum pressure adjustment of the variable displacement pump is effected by simple manipulation of the control handwheel on the pump. Once this pressure adjustment has been set for the correct value for a particular operation, it requires no further attention. All component parts of this press not functional in its operation are enclosed, although readily accessible for inspection and maintenance. This results in an appearance that is pleasing to the eye and is in accordance with the present-day trend in industrial design.

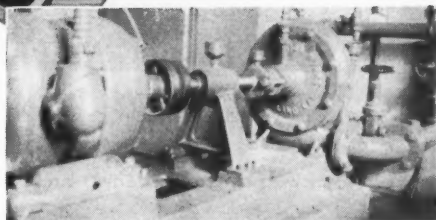
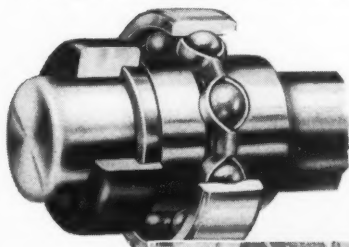
Magazine Feed For Landis Automatic Forming and Threading Machine

With the Landis Automatic Forming and Threading Machine manufactured by the Landis Machine Company of Waynesboro, Pa., the bolts are usually fed into the transfer mechanism automatically from a hopper. The machine will feed automatically bolts from $\frac{1}{8}$ in. to $\frac{3}{4}$ in. or 1 in. diameter, with thread length up to $2\frac{1}{2}$ in. and bolt lengths from 1 in. to 6 inches.

In order to provide for increasing the capacity of the machine to take bolts longer than 6 in., a magazine feed has been designed recently and placed on the market by this company. The magazine will handle bolts up to $7\frac{1}{4}$ in. long, which is the maximum length which can be taken by the transfer mechanism. By removing the hopper

The RIGHT Fafnir Here meant NON-STOP service

SINCE
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Over 75,000 hours at 1,760 r.p.m. That is the record performance of a 2" x 10" Runner Centrifugal Pump furnished by the United Iron Works for the Clairmount Transformer at the Pacific Coast and Electric Company's station in Oakland. Installed in 1922, this pump has operated over 100 hours a week on Fafnir Wide Inner Ring Ball Bearings ever since, without any attention to the bearings except occasional lubrication.

All Fafnirs have the friction-free strength assured by deep races and large balls of scientifically selected alloy steel. They are made by craftsmen and are subjected to unflinching inspections which guarantee uniform high quality. But, in addition, Fafnir Ball Bearings are made in a line so complete as to assure the exact combination of features which will provide, most economically, full protection for every gear, shaft and wheel they support.

Specify Fafnir Ball Bearings. Then take full advantage of the specialized engineering service which offers designers and builders the assurance that the unit exactly suited to the load and service conditions will be selected. Full cooperation is yours for the asking. THE FAFNIR BEARING COMPANY, New Britain, Conn. Atlanta . . . Chicago . . . Cleveland . . . Dallas . . . Detroit . . . Kansas City, Mo. . . Milwaukee . . . Minneapolis . . . New York . . . Philadelphia.

WORTHWHILE economies in design and production are given in every issue of Fafnir's house organ, "THE DRAGON". We will gladly add your name to the mailing list.

FAFNIR BALL BEARINGS



Radial Thrust

Double Row

Duplex

Single Row Radial

Grease Shield D Type

Felt-Seal T Type

Self-Aligning S Type

Self-Aligning L Type

Thrust

leaf, the magazine can be attached directly to the hopper. The installation can, therefore, be made to machines in service.

The bolts must be placed in the feed-



Magazine Feeds for Landis Automatic Forming and Threading Machine

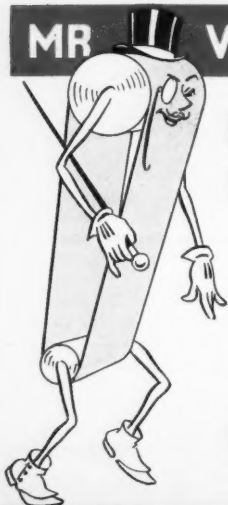
ing chutes of the magazine by hand, after which they are automatically fed to the grippers, pointed, threaded, and

ejected. All factors remaining equal (diameter, pitch, thread length, and cutting speed), production will be identical with that of regular machine equipment with hopper leaf for fully automatic feeding. The capacity range of the magazine feed is up to $2\frac{1}{4}$ in. length of thread on $\frac{1}{8}$ in. to 1 in. or 1 in. diameter bolts, from $2\frac{1}{2}$ to $7\frac{1}{4}$ in. long and with bolt thickness up to $1\frac{1}{4}$ in. The length of the magazine chute is 35 inches from the loading end to the feeding end and the number of bolts which it will hold at one time is governed by the size of the bolt heads. For bolts shorter than 1 in., the regular hopper leaf type should be used.

Niagara Master Series A Inclinable Press

To the line of stamping presses made by Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., has been added the Master Series A Inclinable Press shown in the illustration. This press is of the smaller size, having a $1\frac{1}{4}$ -in. diameter shaft, and has been designed especially for use in manu-

MR. WELL DRESSED BELT...



HAS A LONGER USEFUL LIFE...

Belts treated regularly with Research Belt Dressing have a longer productive life than untreated belts. Enthusiastic users of Research tell us that regularly treated belts not only last longer but also enable them to step up machine speeds with a resultant production bonus. Order a can from your nearest distributor or write direct to the Home of Research.

Graton & Knight Company
WORCESTER - - - MASS.

QUART \$1.00
 $\frac{1}{2}$ GALLON \$1.50
GALLON \$2.75
5 GALLON \$12.50

RESEARCH BELT DRESSING

from the Home of Research

WE ASK YOU--

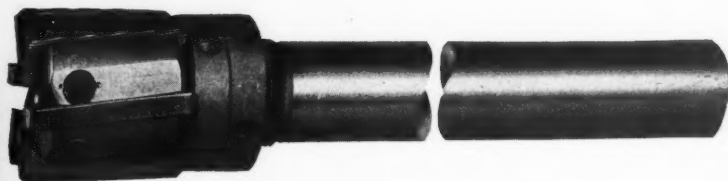
Does your reamer grinding life cost as little as

2c per .001"

It would if you were using

G & G

SERRATED BLADE CAM LOCK REAMERS

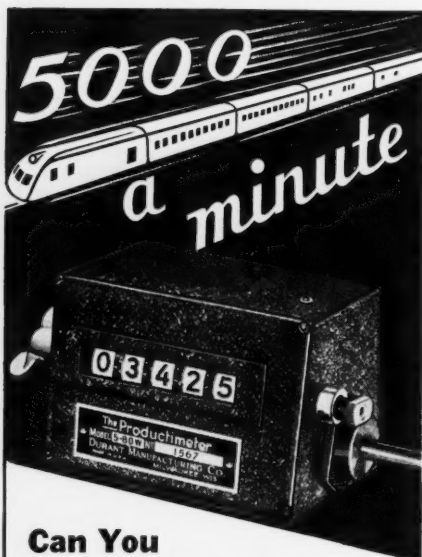


Divide the cost of a set of the reamer blades you are using by the number of thousandths of an inch of grinding life they will provide and decide on their economy for yourself.

Serrated blade cam lock reamers provide as much as $\frac{5}{8}$ " grinding life on the diameter of the $4\frac{1}{2}$ " size. Other sizes proportional.

GODDARD & GODDARD Co.

DETROIT, MICH.



Can You Count That Fast?

This Productimeter, 5-BDW-7 is our answer to the demand for a counter capable of recording for modern high speed machines and instruments. It is a precision counter, the fastest made today, and will keep step accurately with production or testing machines with speeds up to 5000 r.p.m.

No matter what you have to count or measure you will probably find in the Productimeter line of stroke, rotary, lineal, and electrical counters a model that will enable you to keep reliable production records.

Productimeters

THE SPEEDOMETERS OF INDUSTRY

DURANT MFG. CO.

1932 N. Buffum St.
Milwaukee, Wis.

173 Eddy Street
Providence, R. I.

TELL US WHAT YOU WANT TO COUNT

turing light metal stampings such as used in the jewelry, automotive, and electrical, toy and other industries using small parts. The A-1 1/4-In. Press has, however, been designed along the lines of the larger presses in the Niagara Master Series line.

The press is equipped with the Niagara 14 point engagement sleeve clutch which has been designed to provide the utmost of safety, maximum strokes per minute and long life. Flywheel and thrower spindle are mounted on anti-friction



Niagara Master Series A Inclinable Press

bearings. The sleeve clutch is equipped with a positive stop, locking device and single stroke mechanism. The slide operates in double "V" adjustable gibs and provides equal support for the die from center to front and center to rear. The breech block die clamp provides solid support to the die under pressure.

The press is equipped with an inclining device which reduces handling time by allowing material automatically to drop through to the rear of the press after each stroke. The press is so designed that there is practically no change in the bed height when in the inclined position.

**BARBER-
COLMAN**

HOBBS

UNEXCELLED

**ACCURACY
QUALITY
SERVICE**



**BARBER
B-C**

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PRODUCTS

**MILLING CUTTERS,
HOBBS, HOBGING
MACHINES, HOB
SHARPENING MA-
CHINES, REAMERS,
REAMER SHARP-
ENING MACHINES,
SPECIAL TOOLS**

Write Today for Catalog J

BARBER-COLMAN COMPANY

General Offices and Plant, ROCKFORD, ILLINOIS, U. S. A.



**Standardized
JIG BUSHINGS**
Acme Standard
over 6700 items
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over 4200 items

Acme Drill Jig Bushings are made by the most exacting, scientific methods—insuring long wear, accurate fit, and absolute satisfaction. A standardized product, carried in stock for prompt delivery in over 10,900 standard items—all completely finished and ready for use. Special sizes made to order.

Send for bulletin, containing complete details, sizes available and low prices.



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Columbia TOOL STEEL

A copy of our
new catalog
just published
will be sent on
request.

*It pays to use
Good Tool Steel.*

COLUMBIA TOOL STEEL COMPANY

MAIN OFFICE AND WORKS

600 E. 14TH STREET CHICAGO HEIGHTS, ILLINOIS

U. S. Tool Company Multi-Miller

A milling machine which can be used either as a high speed semi-automatic miller or as a regulation hand miller has been developed by U. S. Tool Co. Inc., Ampere, N. J. The dual purpose of the machine will make it especially



U. S. Multi-Miller

useful to plants where both large production runs and numerous hand milling operations are the rule.

The power table feed is cam-operated which makes it possible to obtain any desired table feed or combination of speeds, and the changes of table speed and direction are controlled by a single cam and lever which eliminates all danger of "jamming" the work. Hand operation is effected by means of a conveniently located hand lever and affords all the advantages of a hand miller with horizontal feed.

The machine is of compact design and sturdy construction, provision being made in the base for a coolant pump and tank. Controls are arranged for manipulation from operating position.

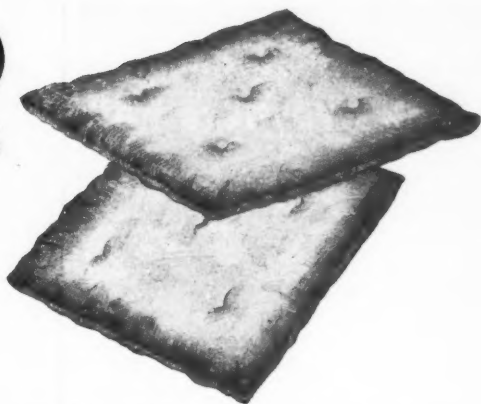
Multi-Miller
can be used
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and miller
Tool Co.
al purpose
special

GOOD

for crackers

BAD

for taps



H EAT applied to crackers or taps makes their thin edges **BURN**.

On crackers, crisp edges are appetizing, but . . . burned edges on tap teeth are brittle and distorted.

Bath engineers have completely eliminated brittleness, chipping, and distortion, by grinding the teeth from the solid blank **AFTER** it has been properly hardened. Rockwell testing shows that the thinnest edges of the teeth then have the same perfect grain structure as the core itself, and the results are . . .

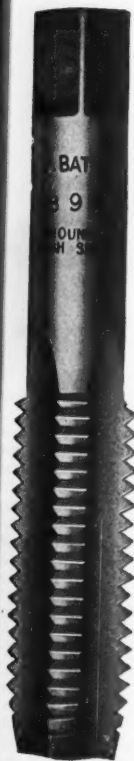
- Longer life between grinds
- More positive cutting
- Extreme accuracy
- Greater savings

The super finish of the teeth . . . highly polished flutes . . . lapped centers . . . and the file hard tops, all insure the tremendous productive capacity of BATH TAPS.

*Let us make a survey of your tapping problems.
No obligation for this chance to save on your tapping.*

John Bath & Company Inc.

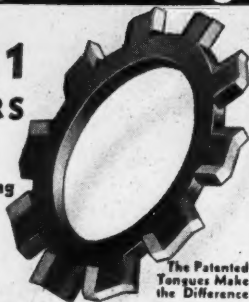
WORCESTER, MASS.



When other Lock Washers Fail Use *Everlocks*

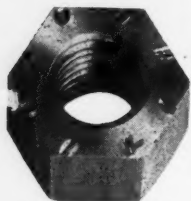
THE 2 IN 1 WASHERS

that Combine
Positive Locking
and Powerful
Spring Tension



The Patented
Tongues Make
the Difference

In case after case where other lock washers fail, Everlocks have made good.



This halftone reproduction of an unretouched photograph shows why. With the many sharp teeth forced into the nut by powerful spring tension positive locking is assured — vibration can never shake it loose.

Why subject your equipment to the hazards of loose nuts, when positive locking, combined with spring tension costs so little?

Write for free testing samples and judge for yourself Everlock positive protection against loosened nuts.

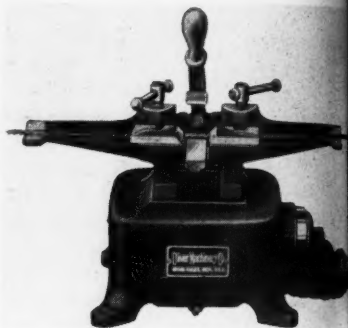


U. S. Patent
No. 1775705

Thompson-Bremer & Co.
1640—E. W. Austin Ave., Chicago, Ill.

No. 462 Oliver Vulcan Electric Brazier

An electric brazier for brazing together the ends of band saw blades, known as the No. 462 Oliver Vulcan Electric Brazier, is now being marketed by Oliver Machinery Co., Grand Rapids, Mich. It is stated by the manufacturer that this brazier makes a perfect, accurate band saw joint as smooth and strong as the saw itself. The brazier is equally efficient on saws for cutting metal and wood. The Oliver Vulcan Electric Brazier utilizes the electric heat of resistance for melting down the soldering material. The brazier is well insulated and the voltage at the point of action is so low that no shock can be given to the operator.



No. 462 Oliver Vulcan Electric Brazier

ator. There is no danger of fire, combustion, and no formation of smoke on the saw blade.

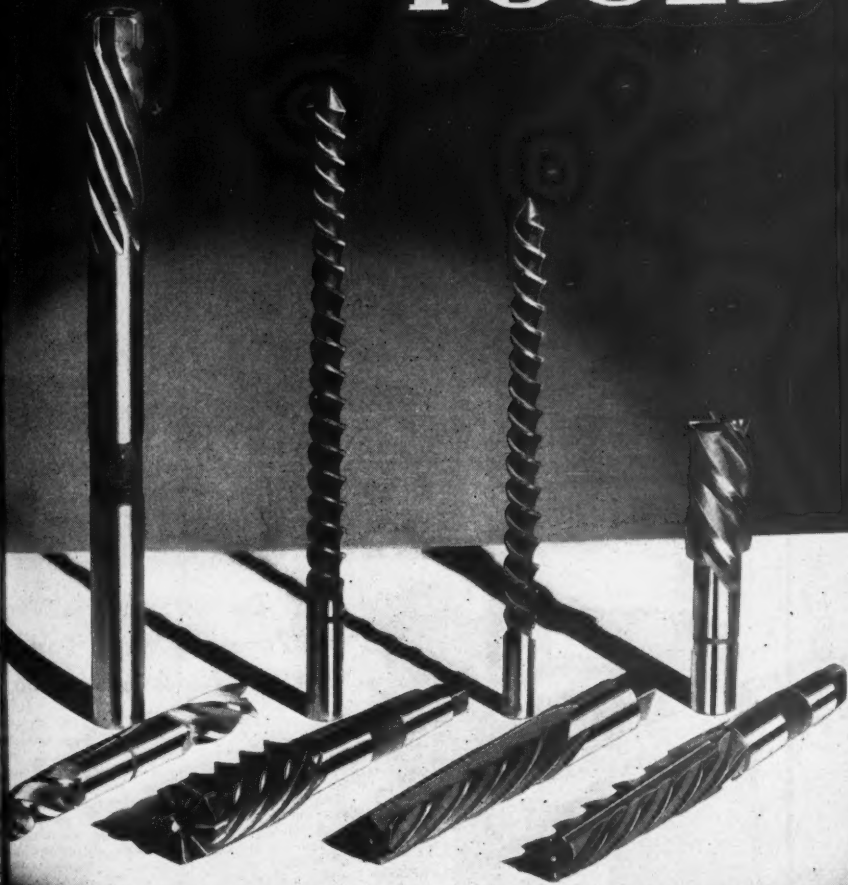
The brazier is regularly furnished for single phase, 60 cycle, 110 or 220 volt alternating current. A 60 cycle brazier will work on 30, 40 or 50 cycles. For other cycles and voltage the brazier may be specially wound.

The top part or bed of the brazier consists of a back rail, clamp plates and clamps accurately fitted to hold the saw and maintain it in perfect alignment. To operate, the saw ends are beveled and overlapped from 1/3 to 1/2 in., then a strip of 1/2 to 3/4 in. solder is placed between them and the switch is turned. After some seconds the brazing seam will glow and melt down the joining metal. It is stated that the current can be controlled so as to prevent overheating of the saw blade. More than 100 brazings can be effected by the use of one kilowatt hour of current.

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GAMMONS TOOLS



SPIRAL SPECIALISTS

GAMMONS HOLMAN CO.

MANCHESTER, CONN.

Thor No. U-58 Portable Electric Sander

The Independent Pneumatic Tool Co., 610 W. Jackson Blvd., Chicago, has brought out the U-58 Portable Electric Sander shown herewith.



Thor No. U-58 Portable Electric Sander

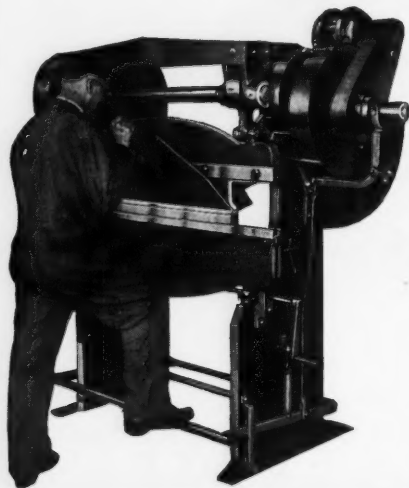
The U-58 Sander is intended for sanding, grinding, cleaning, preparing automobile bodies and fenders for paint jobs, smoothing wood surfaces and every application which might involve sandpaper or emery. Perfect balance and ease of handling permit most efficient operation. Armature and spindle run in ball bearings, giving wheel maximum torque. Accurately cut gears of alloy steel, heat treated, can be taken apart for inspection or cleaning with excep-

tional ease. Inspection of the machine can be made while the sander is running by simply removing two brush covers. Side handle can be used on either side of machine. Equipped with 7-1/2 flexible rubber pad and a box of two assorted abrasive discs.

Monarch Direct Length Reading Dial

The illustration shows a Monarch Direct Length Reading Dial as applied to a Monarch Lathe. These dials can be applied, where desired, to lathes now in use. The direct length reading mechanism, illustrated, consists of a small oil-tight gear housing approximately 6 1/4 in. high, 5 in. wide, and in. deep overall. This unit is intended to be attached to the left hand or right hand carriage wing and takes the place of the carriage glib. A hardened pinion meshes with the bed rack and through the gearing in the housing one foot length of carriage travel produces one complete revolution of the inner dial. One inch of carriage travel also produces one revolution of the outer dial which is graduated in 64ths of an inch of carriage travel. Both dials can

THIS No. 253 CHICAGO STEEL PRESS



Will Do 40% to 60% of the Forming Work Turned Out by the Average Shop

This compact, ruggedly built, 48", No. 253 gauge capacity, Chicago Steel Press breaks down an economical and profitable production unit. It is ideally adapted for rapidly forming metal sections such as in stoves, refrigerators, soda fountains, steel cabinets, metal furniture, steel boxes and a great variety of sheet metal specialties. Variable speed drive operates from 17 to 50 strokes per minute. Precision built of highest quality materials by master craftsmen.

Write for Circular No. 253

DREIS & KRUMP MFG. COMPANY

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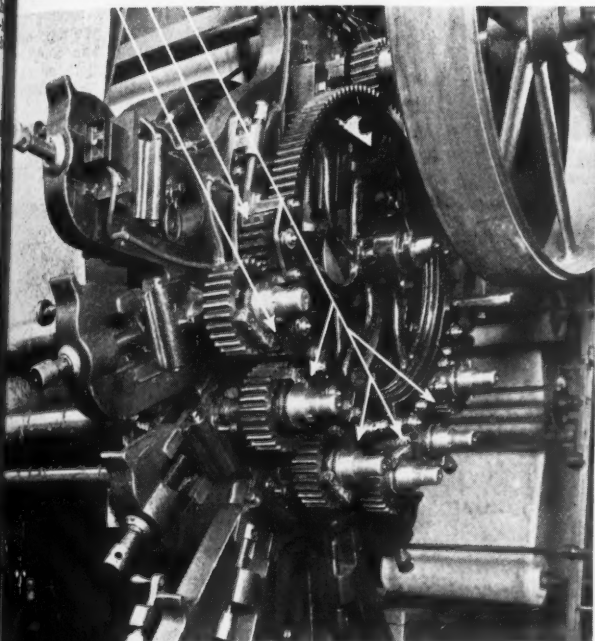
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FORMICA IDLER GEARS



-in a Textile Drive

SEVERAL Formica idler gears were used by Rice, Barton & Fales of Worcester, Mass., in the drive, on which they hold patents, for this printing machine.

There has been a steady drift toward Formica gear drive because of its silence, its simplicity and few moving parts, light weight and great durability.

Formica is a friend to the machinery salesman, because his smoothly and silently operating equipment is easier to sell. It greatly helps the maintenance man to keep his machinery operating sweetly and smoothly.

The gear cutters named can provide promptly Formica gears in large or small quantities.

The Formica Insulation Co.
4640 Spring Grove Ave.
Cincinnati, Ohio

FORMICA

NON-METALLIC GEARS

• FORMICA • GEAR CUTTERS

- The Akron Gear & Eng. Co., Akron, O.
- Farrel-Birmingham Co. Inc., Buffalo, N. Y.
- Slaysman & Company Baltimore, Md.
- Harry A. Moore Bangor, Me.
- The Union Gear & Mach. Co., Boston, Mass.
- The Atlantic Gear Works New York City
- Chicago Rawhide Mfg. Co. Chicago, Ill.
- Perfection Gear Company Chicago, Ill.
- The Mechanical Specialty Mfg. Co., Chicago, Ill.
- Merkle-Korff Gear Co. Chicago, Ill.
- Chicago Gear Company Chicago, Ill.
- The Cincinnati Gear Co. Cincinnati, O.
- The Horsburgh & Scott Co. Cleveland, O.
- The Stahl Gear & Machine Co., Cleveland, O.
- The Master Electric Co. Dayton, O.
- The Adams Company Dubuque, Ia.
- The Ferguson Gear Co. Gastonia, N. C.
- Hartford Special Mach. Co. Hartford, Conn.
- Beatty Machine Works Keokuk, Ia.
- The Generating Gear Co. Milwaukee, Wis.
- Badger State Gear Co. Milwaukee, Wis.
- Precision Machine Co. Milwaukee, Wis.
- E. A. Pynch Co. Minneapolis, Minn.
- Joaquin Alemayn Lopez Havana, Cuba
- New Jersey Gear & Mfg. Co., Newark, N. J.
- Prager, Inc. New Orleans, La.
- J. Morrison Gilmour, 151 Lafayette St., New York City
- Sier-Bath, Inc. New York City, N. Y.
- E. M. Smith Machine Co. Peoria, Ill.
- The Eagle Gear & Mch. Co. Philadelphia, Pa.
- Rodney Davis and Sons Philadelphia, Pa.
- The Pittsburgh Machine & Supply Co., Pittsburgh, Pa.
- Standard Gear Co. Pittsburgh, Pa.
- H. W. Honeyman & Son Providence, R. I.
- Perkins Machine & Gear Co., Springfield, Mass.
- Winfield H. Smith, Inc. Springfield, N. Y.
- Ailing Lander Company Sodus, N. Y.
- Charles E. Crofoot Gear Corp., South Easton, Mass.
- Arlington Machine Co. St. Paul, Minn.
- Farwell Mfg. Co. Toledo, O.
- Diefendorf Gear Corp. Syracuse, N. Y.
- Worcester Gear Works Worcester, Mass.
- Massachusetts Gear & Tool Co., Woburn, Mass.

**"This OLIVER
sure is a great
GRINDER"**

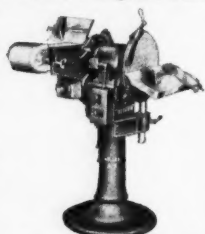


On small tough jobs . . . grinding away bits of metal quickly, smoothly, and on polishing you'll find this "Oliver" Grinder a great time and labor saver. Fine for circular and angular work. Table tilts 45° down, 25° up. Sturdily built. It's the patternmaker's favorite, too. Operates from light socket.

Write for Full Details

**Among its users
are**

Ford Motor Co. (2)
Hudson Motor Co.
(2)
General Electric Co.
Western Electric Co.
Ingersoll Rand Co.

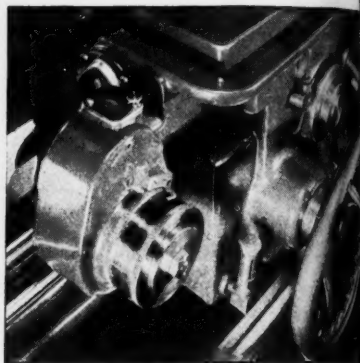


**Disc and Belt
Grinder for straight
line and general
work.**

Oliver Machinery Co., Grand Rapids, Mich.

quickly reset to zero so that successive length measurements in turning or boring can quickly be made and directly read on the dials.

It is obvious that in machining even one piece having various lengths, whether boring or turning, the length reading dial will save the operator the time of stopping the lathe to measure the length of the cut by the use of a scale in the usual manner. Where a lathe is equipped with multiple automatic length feed stops, the direct



Monarch Direct Length Reading Dial

length reading dial will be found to be most convenient in setting the various length stop dogs, especially when the first piece of a lot is being machined. The case is oil tight and the gears and operating parts operate in a bath of oil which is readily supplied through an opening in the top of the case as shown.

Beaver Model A Special Pipe Machine

The Model A Special Pipe Machine shown in the illustration has been placed on the market by Beaver Pipe Tools, Inc., Warren, Ohio. The machine will cut, thread, ream, and chamfer all sizes of pipe from 1/4-in. to 2-in. diameter. It will operate geared tools to cut and thread 2 1/2-in. to 12-in. pipe, and it will cut off solid round bars of stay rods 1/4-in. to 1-in., and thread bolts and stayrods from 1/4-in. to 2-in.

The machine is available in two models—standard and special. The special model is equipped with a wheel-and-roller cutoff and manual feed. The

STERLING HIGH SPEED CUT OFF WHEELS

STERLITH - BAKELITE
STERBON



STERLING is proud to offer STERBON and STERLITH Bakelite cut-off wheels -- modern wheels for modern high-speed cutting. Maximum production and minimum wheel wear with STERLING super-speed wheels, structured for fast clean cutting. Any size, grain or grade to meet your requirements. We suggest STERLING -- the dependable wheel -- for that next job.

THE STERLING GRINDING WHEEL COMPANY

Abrasive Division of The Cleveland Quarries Co.

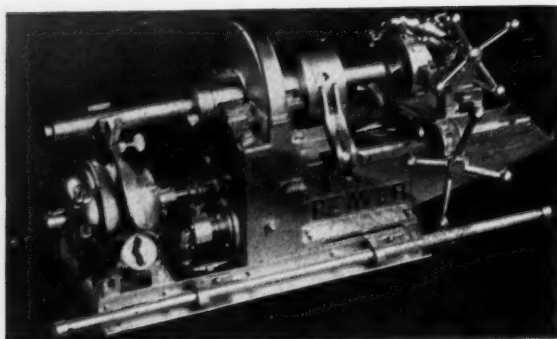
Factory and Office:
Tiffin, Ohio



CHICAGO: 133 N. Wacker Drive
DETROIT: 101-107 West Warren Avenue

STERLING

ABRASIVES



Beaver Model A Special Pipe Machine

fixed workhead does not tilt back. Cutting range is from $\frac{1}{8}$ in. to 2 inches. The wheels and rollers are standard. The machine will cut steel, wrought iron, brass, copper or cast iron pipe.

The standard model has a knife-type cut-off and automatic feed. The workhead tilts for making up fittings and the cutting range is from $\frac{1}{2}$ in. to 2 inches. The knives feed automatically, and cut square without leaving a burr.

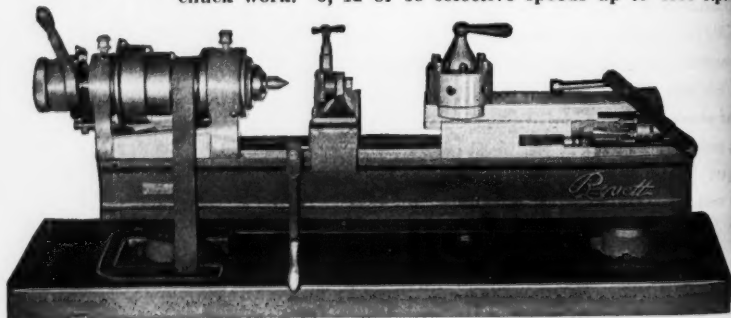
No gauge is required to set the knives. A safety guide prevents hogging in by the knives. Knife blocks are backed by heavy springs, cushioning the shock when cutting out-of-round pipe and preventing knife breakage.

Both models are built to conform to standard machine tool design with the chuck to the left and tool mounting to the right of the operator. All controls are in front within easy reach. An all-steel 3-jaw universal chuck is standard equipment. Pipe is

supported by an outboard pipe support. Oil lines are concealed, and the oil pump is easily accessible. All trace of burr is instantly removed by the use of an 8-fluted alloy tool-steel reamer which swings in and out of working position. All housings, body castings and carriage support are of a select grade of nickel-iron, insuring strength and durability. The machine is painted a battleship gray.

RIVETT ANTI-FRICTION SPINDLE BENCH LATHES

are high production low cost machine tools for small bar or chuck work. 6, 12 or 18 selective speeds up to 4600 r.p.m.

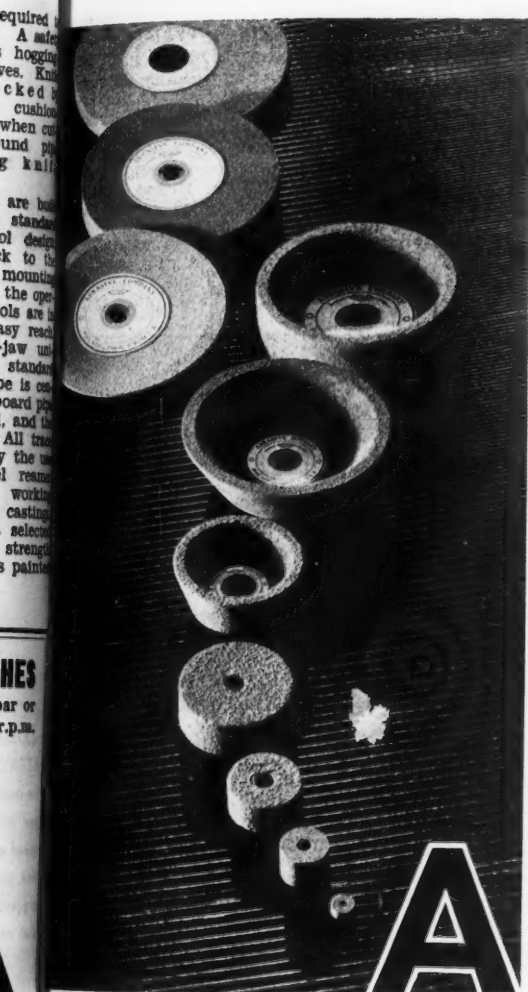


Built with Timken Zero Precision roller bearing or Preloaded ball bearing heads. Collet capacity up to 1" diameter. Swing 8". Roller bearing lever chuck closer. Automatic six station turret. Cutting off and forming slide. Speed box drive with automatic brake. Oil pan.

Write for Bulletin 505-RB and price list.

RIVETT LATHE & GRINDER INC.

BRIGHTON, BOSTON, MASS.



TOOL ROOM Grinding Wheels

SB Borolon (special aluminum oxide) vitrified bonded grinding wheels are expressly manufactured for the particular requirements of tool and cutter grinding.

Careful control of grain size, bond content, density—in fact—of every detail of manufacture results in wheels with a cool, fast cutting action combined with satisfactory wheel life.

Modern grinding practice will be better served in your tool room if SB Borolon vitrified bonded wheels are specified. A variety of sizes, shapes and grains and grades meet all requirements. May we send details?



ABRASIVE COMPANY

Tacony and Fraley Sts., Philadelphia, Pa.



DIVISION OF SIMONDS SAW AND STEEL CO.

Driver Portable Heavy Duty Flexible Shaft



PR102

Complete
with $\frac{1}{2}$ H.P.
Capacitor
Type Motor

\$59.50

Write Dept. M83 for
fully illustrated folder.

Here is a real portable machine built for long, hard use. Equipped with SKF ball bearings for smooth, quiet operation. Does innumerable jobs—sanding, grinding, drilling, cleaning, buffing, rotary filing, reaming and many other operations. It has a telescoping type stand, giving 15" additional height. Height normal position 42", raised 57". Motor swivels and locks in any position. Motor and yoke is detachable for overhead suspension. Large base holds tools. Has large, heavy duty SKF ball bearing hand piece with $\frac{1}{2}$ " spindle. Casing is rubber covered.

*All Types of Flexible Shafts Made to
Specification.*

Walker-Turner Co., Inc.

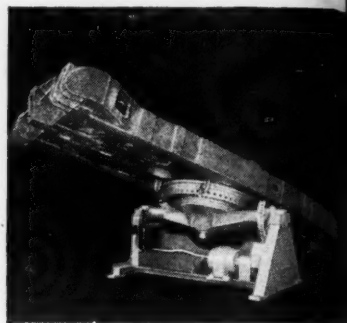
Plainfield

New Jersey

Harnischfeger Positioner Aids Welding Operations

To aid in putting welding on a more efficient basis, the Harnischfeger Corporation, Milwaukee, Wis., has developed a number of standardized fixtures, one of which is shown in the illustration. The unit shown, known as the No. P-10, is designed with a tilting turning arrangement upon which pieces weighing as much as 4 tons can be handled, enabling the operator to locate his work in the proper welding position with a minimum of effort and time.

The Harnischfeger P-10 welding positioner



No. P-10 Harnischfeger Welding Positioner

tioner has a 48-in. revolving table which is manually operated, turns on roller bearings, and is self-locking in positions. The table tilts 90 degrees in one direction and 45 degrees in the other, the tilting mechanism being electric motor driven through a double reduction bronze worm gear so that it moves smoothly and can be accurately stopped at any angle by means of push button control.

The motor is supplied for either a.c. or d.c., with limit switch control. A safety factor incorporated in the design will permit carrying up to 25 per cent overload.

Mico Precision Square

The illustration shows a precision square which has been placed on the market by the Mann Instrument Company, 10 Arrow St., Cambridge, Mass. The square is of cast iron which has been heat treated between the preliminary and final machining operations to relieve internal strains. The square measures $4\frac{3}{4} \times 4\frac{1}{2} \times 1\frac{1}{2}$ in., providing

INTRODUCING

**30 LUMENS
PER WATT**

New
**250 - WATT
MERCURY
VAPOR LAMP**

**FOR VERTICAL,
HORIZONTAL OR
ANGULAR MOUNTING**



For applications which do not permit the use of the standard 400-watt high intensity mercury vapor lamp, General Electric has developed this companion lamp. It is of the universal burning type, functioning efficiently in the vertical, horizontal or angular positions. It produces as much light as is developed by 425 watts of Mazda light and has an operating life rating of 2,000 hours.

Used alone, this new lamp provides efficient lighting in low bays. In combination with Mazda lamps the intermingling of colors produces approximately a cool white light, highly desirable for factory and office. Write for complete information.

Order your auxiliary devices which were designed especially for this lamp from the General Electric Vapor Lamp Company.

GENERAL  ELECTRIC

GENERAL ELECTRIC VAPOR LAMP CO.
897 Adams Street, Hoboken, N. J.

INCANDESCENT LAMP DEPARTMENT
Nela Park, Cleveland, Ohio



Mico Precision Square

right angle surface which will be suitable for the majority of machine shop operations. After finished machining, the faces of the square are scraped so that the right angle is accurate to within

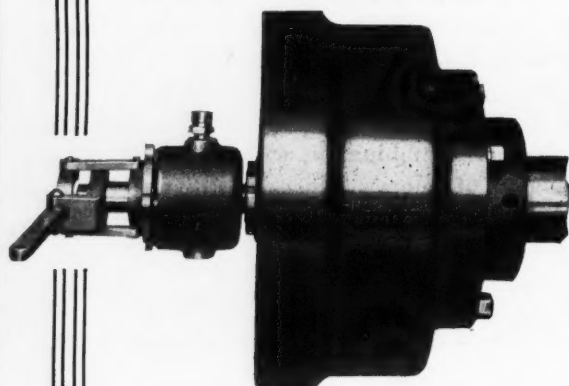
0.0001 in. in $4\frac{1}{2}$ in., making the square suitable for tool room and laboratory work as well as for general machine shop work where close accuracy is desired.

Marsh Universal Socket Dial Thermometers, Types 61 and 62

Universal Socket Dial Thermometers in both the self-contained and in the distant reading type are now being made by Jas. P. Marsh Corporation, 2075 Southport Ave., Chicago, Ill. The self-contained instrument, identified as the Type 61, is fitted with a Marsh universal socket which permits the use of the one instrument as a vertical connection thermometer, a 90 deg. back angle thermometer, a front angle thermometer, or for use at any intermediate angle. It eliminates the necessity of specifying a different type of stem for each particular application. Thus the user may apply a single instrument of a given range to practically any installation.

The Type 62 distant reading thermometer is standard with six feet of connecting tube and a union bulb, or in the case of high temperature thermometers, either a union bulb or a flexible plain bulb. The thermometer

NO SEPARATE VALVE —



is required for Hopkins Series "C" Cylinders. The valve is a part of the distributor. These cylinders require only a rod from the distributor lever along the front of the machine to a convenient position for the operator. The additional piping, which is necessary for the separate valve, is eliminated.

Write for Catalog

THE TOMKINS-JOHNSON COMPANY

620 N. Mechanic Street, Jackson, Michigan

the square
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machine shop
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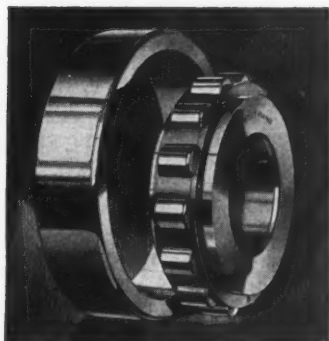
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WHERE NO OTHER TYPE OF BEARING WILL



STAND UP

Because of Extreme Load Conditions, Use

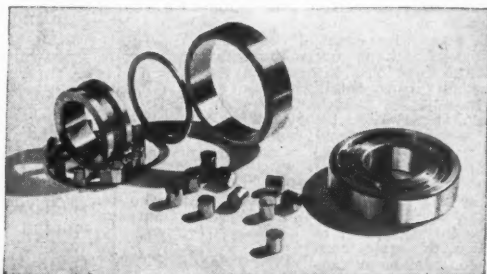
PRECISION ROLLER BEARINGS

With the Heavy Bronze Cage

Picture to yourself the most difficult load conditions a bearing can be called upon to meet—high speed, heavy load, temporary overloads, shock, vibration. Then read, in the adjoining column, how NORMA-HOFFMANN Precision Roller Bearings—time-tested heavy-duty units—meet these conditions.

• • •

And remember—PRECISION Roller Bearings interchange in size with all standard ball bearings. They can be had—in addition to the standard type here illustrated—in one-lip, two-lip (self-contained), full roller type (without cage), self-aligning and adapter types.



PARALLEL LINE CONTACT

Solid cylindrical rollers between cylindrical races providing maximum load contact area, increased steady load capacity, and a larger shock-absorbing capacity than any other type of single-row bearing.

SAFETY FACTOR

A single sample for temporary overloads up to 50% beyond normal rating, at under peak load, in unusually severe duty, or under shock conditions.

SUPERIOR CAGE

Hubs of extruded bronze to secure maximum ductility and uniformity—machined all over for balance—riding on inner ring lands or shoulders, relieving the rolling elements of its weight.

EXTREME ACCURACY

Rollers held to .0001 inch on diameter and to .0002 inch on length, throughout—absolutely true rolling surfaces, ends absolutely square with the sides—highly polished, quiet, friction-free.

DURABILITY

Uniform contact throughout the length of the rollers, providing the most efficient load distribution—greater wear-resisting surfaces—true rolling between all load contact areas—minimum friction between rollers and cage.

SPEED QUALITIES

A lower friction coefficient under heavy load than any other type of bearing—a speed ability equal to that of any ball bearing, size for size, up to 35,000 R.P.M.

There's no duty too hard for a PRECISION Roller Bearing. And, for the less exacting duties, there are PRECISION Ball and Thrust Bearings. Write for the Catalog—ask our engineers for suggestions.

NORMA-HOFFMANN

PRECISION BEARINGS

BALL, ROLLER AND THRUST

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.

No. 10 of the Series

WHAT ARE THE VARIOUS COATED ABRASIVES?

What Are Their Uses? HOW TO ORDER CORRECTLY

By E. B. GALLAHER
Editor, Clover Business Service
Treasurer, Clover Mfg. Co.

IN THIS SERIES OF ADS we have described the various Coated Abrasives—their construction—their uses. We have stressed the importance of getting the right abrasive, on the correct backing, for the special work in hand.

Our last ad told you how to identify the 5 shop abrasives—we showed you how confusing it is to have these 5 abrasives listed under 40 or more trade names—a trade name which rarely identifies the real abrasive.

We told you how we have guarded against mistakes in identification by adopting "COLOR-STRIPES" which are printed on the back of each sheet: **GREEN** for **FLINT**—**RED** for **EMERY**—**YELLOW** for **ALUMINUM OXIDE**—**ORANGE** for **GARNET**—**BLUE** for **SILICON CARBIDE**.

● We now wish to emphasize the importance of ordering correctly, and how it may be done.

● There are 5 basic points to be remembered when ordering Coated Abrasives—none of which should be omitted from the order.

1. Type of Abrasive—Flint, Emery, Garnet, Aluminum Oxide, Silicon Carbide.

2. Grade of Abrasive—Call for exact size of abrasive—use catalog symbols.

3. Backing—Paper; Cloth ("X" Drills, "J" Jeans); Combination.

4. Coating—Specify Open Coat or Closed Coat.

5. Size—Give exact dimensions.

● The merchant or manufacturer must always have this information so that he may fill orders intelligently.

● In addition it is well to state whether the material is to be used for wood-working or metal-working, and whether flexibility or non-flexibility is desired. (See No. 8 of the Series)

● Coated Abrasives are highly technical—those who use them, as well as those who make and sell them, should use extreme care in specifying, in order to avoid confusion, delay, or possible failure to obtain desired results.

● File these ads for reference.

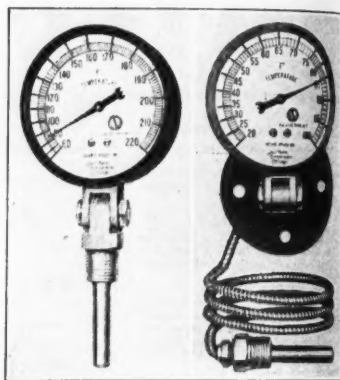
CLOVER MFG. CO.,

NORWALK,
CONN.

Also makers of the famous
**CLOVER GRINDING AND LAPPING
COMPOUNDS**

has a mounting flange together with the universal socket which permits the installation of the instrument proper to any convenient point on top or in front of the apparatus or on a wall or pillar with the bulb installed at the point of temperature.

A complete assortment of Fahrenheit scale ranges for all requirements from 20 deg. below zero up to 800 deg. above zero or corresponding centigrade scale is available. The graduation arc on the dial of these instruments and the distance traveled by the pointer is equivalent



Marsh Universal Socket Dial Thermometers
Types 61 and 62

lent to approximately the operating scale length used on most 9-in. scale size industrial thermometers of the glass tube type. Furthermore, the type of graduation and numerals employed, together with the pointer type indication, make this instrument legible at considerable distances.

The instruments are manufactured in 3½-in. dial size only and are standard with black crystal finish all over, black crystal finish with nickel plated trim, polished brass finish all over, or nickel plated finish all over. The instruments are available with a wide variety of bulbs for a variety of applications.

RFC Rotary Files

The Rotary File Company, Stratford Conn., is marketing a complete line of hand cut high speed rotary files, together with a line of rotary rasps. Some of these files are of high speed steel and others are of carbon steel, the latter



Floating Tool Holders Insure Accurately Reamed and Tapped Holes



Extended Type



Quick Change

Compensates automatically for misalignment between machine spindle and the work.

Taps produce thread with uniform pitch diameters.

Reamers finish holes true to size.

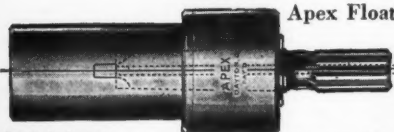
Prevents taps and reamers from breaking and eliminates bell mouthed and oversize holes.

Used by hundreds of manufacturing companies whose repeat orders are proof that Apex Floating Holders reduce costs and tool breakage.

Sockets are furnished for Morse Taper or straight shank tools. Shanks can be furnished in any Morse Taper or straight diameters to fit any machine spindle.

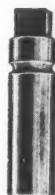


Tap Collet



Inserted Socket
Type for Screw
Machine Use

Apex Floating Holders are also furnished with Quick Change bottoms so that collets for Morse Taper, straight shank tools and taps may be quickly changed.

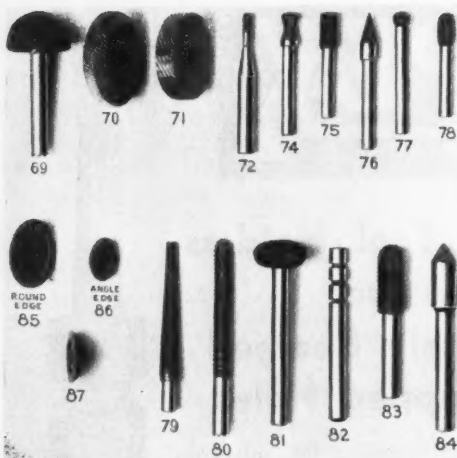


Reamer Collet

Write for Catalog No. 8 for full information.

THE APEX MACHINE & TOOL CO.

THIRD AND MADISON STREETS, DAYTON, OHIO



RFC Hand Cut High Carbon and High Speed Steel Files

being recommended for use on mild steel, aluminum, soft brass, copper, and other softer substances. The high speed steel

files are generally used on steel, iron and harder metals. A number of files with and without shanks are shown in the illustration herewith. The wheel shapes are furnished with $\frac{1}{4}$ -in. stems.

Reich Surface Test Indicator

The Surface Test Indicator illustrated herewith is now being marketed by J. R. Reich Mfg. Co., 333 Triangle Ave., Dayton, Ohio. The Reich Indicator is of small, compact, sturdy, rigid construction and is manufactured from rust-proofed materials. The features of the indicator include mounting of the contact point in centered cone bearings and construction of the frame which makes possible a three-way reading effect. The feeler or contact arm is adjustable 45 deg. either side of center. The arm is provided with integral cone bearings engaging corresponding seats in the housing which may be adjusted to increase resistance or take up wear. The pointer may be caused to move in either direction under the influence of the feeler by shifting a reversing button. The ta-



A Two Purpose Tool THE ROTOR B-3

(1) for grinding - - -

WELDS, CASTINGS, PIPE,
STRUCTURAL SHAPES.

(Capacity—8x1 $\frac{1}{2}$ or 2" cup wheel)

(2) for sanding - - -

SHEET METAL PRODUCTS,
WELDED SURFACES, ETC.

(Capacity—9" sanding pad)

A powerful tool
Weights only 12 $\frac{1}{2}$ lbs.

Try one for 10 days at our risk.

The Rotor Air Tool Co.
5600 Carnegie Ave., Cleveland, O.

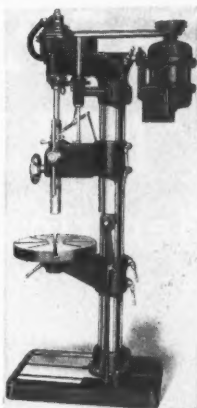
European Representative:
GASTON E. MARBAIX, LTD.
Vincent House, London

DOLLARS!

from these

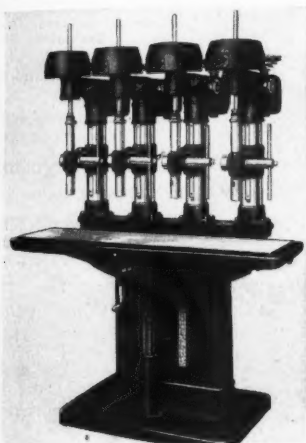
Drill Presses

Probably the most important general characteristics of a drill press are accuracy and reliability. In addition to these, Buffalo drills offer substantial construction (which assures long life); high speeds; wide speed ranges; full line of sizes. Buffalo drills save money for you because they COST LESS to buy—less to operate!



Right: Buffalo No. 22 Drill.

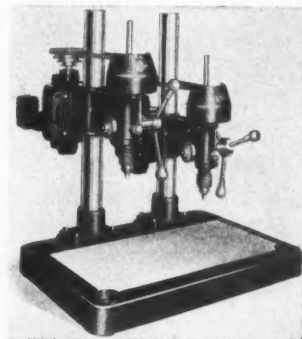
The latest model in our complete line, the No. 22 Drill has speed range suitable for drilling holes from 3/16" to 2", also for tapping and spot-facing. Sturdy in construction, perfectly balanced, extremely accurate—No. 22 has large capacity without being slow and cumbersome. Complete details in Bulletin 2989, sent on request.



Left: A Buffalo No. 16 Four Spindle Production Drill.

One of a complete line of bench and floor type models characterized by ease and speed in handling, so desirable for production work. Bulletin 2730 shows all models.

Right: The "Twin 15"



A newly developed 2-spindle, two-motor bench drill adaptable to any job where you have two operations. LOW in price! Bulletin 2986 describes this drill.

If you want the most for your money when you buy drills, you'll certainly want "Buffalo".

Write for bulletins.

BUFFALO FORGE COMPANY

388 Broadway, Buffalo, N. Y.
In Canada: Canadian Blower & Forge Co., Ltd.,
Kitchener, Ont.

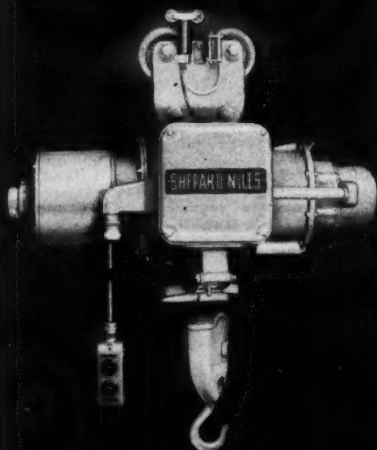
"Buffalo"
for

**Heavy-Duty Drills
for Production Work**

SHEPARD NILES

Electric Hoists

1/4 TO 20 TONS CAPACITY



FLOOR & CAGE CONTROL
ROPE OR PUSH BUTTON
OPERATION — SINGLE
OR VARIABLE SPEED
WRITE FOR CATALOG

SHEPARD NILES CRANE & HOIST CORP.

424 Schuyler Ave., Montour Falls, N. Y.

Export: 111 Broadway, N. Y. C.

MOST COMPREHENSIVE LINE
OF CRANES AND HOISTS

pered indicating surface is graduated on both sides, enabling readings to be taken from either side or from the end. Relative movement of the instrument and work in either direction gives identical readings.

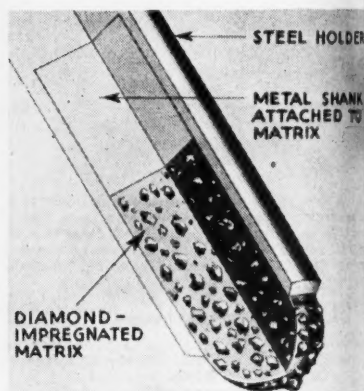
The housing is chromium plated with a satin finish. Graduations are black and the hand is enameled red, making the reading easily visible. A universal holder which is applicable to any machine is supplied with each instrument. This holder enables the instrument to be held in the most convenient position for operation and for reading the graduations.



Reich Surface Test Indicator

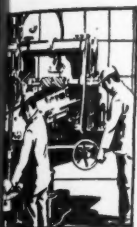
Carboly Diamond-Impregnated Wheel Dresser

Carboly Company, Inc., Detroit, Mich.
manufacturers of Carboly Cement



Carboly Diamond-Impregnated Wheel Dresser

Carbide products, announce the release of an additional grade of their diamond impregnated wheel dresser. The new grade contains an extra coarse mesh of diamonds and has been developed to



THE PIECE-WORKER KNOWS THERE IS A DIFFERENCE

THE MORSE LINE

Includes

High Speed and Carbon
DRILLS, REAMERS
CUTTERS
TAPS and DIES
SCREW PLATES
ARBORS, CHUCKS
COUNTERBORES
MANDRELS
TAPER PINS
SOCKETS, SLEEVES



One of the greatest unofficial testers of small tools is the piece-worker. His pay envelope is a reliable indicator of how well the cutting tool is standing up — how rapidly and economically it is performing.

Piece-workers know that there is a difference in small tools. The fact that they so frequently insist on Morse Tools is one of the sincerest tributes which industry can pay to Morse quality. It is proof positive that you can count on steady production, fewer delays, longer working life from Morse cutters, reamers, drills, taps and dies.

MORSE

TWIST DRILL & MACHINE COMPANY

NEW BEDFORD - - MASS., U. S. A.

There is a Morse
Distributor convenient to you

New York Store: 130 Lafayette Street - - Chicago Store: 570 W. Randolph Street

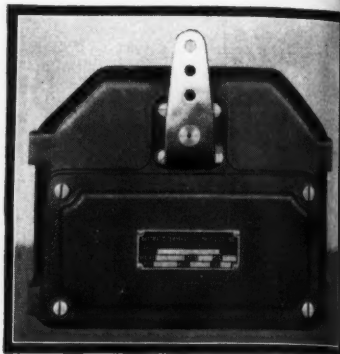
crease the order of performance on the larger and harder grades of grinding wheels used on surface, cylindrical and centerless grinders. This extra coarse grade supplements the existing grades of Carboloy dressers containing fine, medium and coarse mesh size diamonds. With this development, the Carboloy dresser can now be used on all hardnesses and sizes of grinding wheels.

Advantages of the Carboloy diamond-impregnated wheel dresser, as described by the manufacturer, are that no remountings are required, they stand unusual abuse, and each dresser may be used throughout its entire life on the same sized wheel.

"Relatrol" Furnace Temperature Controller

The demand for furnace temperature control with minimum disturbance to furnace atmosphere has led to the development, by the Automatic Temperature Control Co., Inc., 34 East Logan, Philadelphia, Pa., of two new types of multi-position controllers known as the Relatrol and the Balancer. Either unit produces a corrective movement in a valve or damper in exact relation to the departure from the temperature set-

ting as measured by the actuating instrument. This corrective movement follows the temperature changes accurately and promptly.



"Relatrol" Furnace Temperature Controller

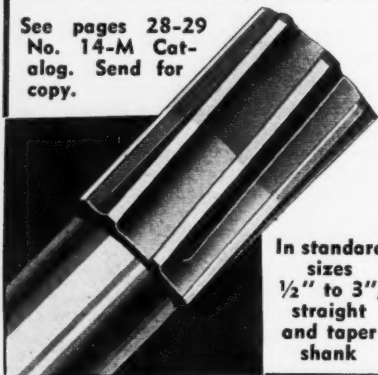
In external appearance the units are identical, and as illustrated. A special relay is supplied, wired into the circuit between the actuating instrument and the motor mechanism. This relay en-

M I D W E S T Expansion Reamers

Maximum strength and elasticity provided by high speed cutting end welded to tough alloy steel shank. Ample high speed section for re-sharpening.

Midwest Tool & Mfg. Co.
2358 W. Jefferson Ave., Detroit, Mich.

See pages 28-29
No. 14-M Cat-
alog. Send for
copy.



In standard
sizes
 $\frac{1}{2}$ " to 3",
straight
and taper
shank

CARSON-NEWTON FILES



TRADE MARK

Alligator Brand Files are available in a complete line of Swiss and American patterns in all sizes, shapes, and cuts to fill every filing need. When you purchase these files, you do so with our guarantee that they have passed the highest tests as to shape, cutting quality and uniform hardness and are perfect in every respect.

Write for catalog
and prices.

Specify files bearing the Alligator trade mark.

CARSON-NEWTON CO.

21-23 Prospect St.

Newark, N. J.

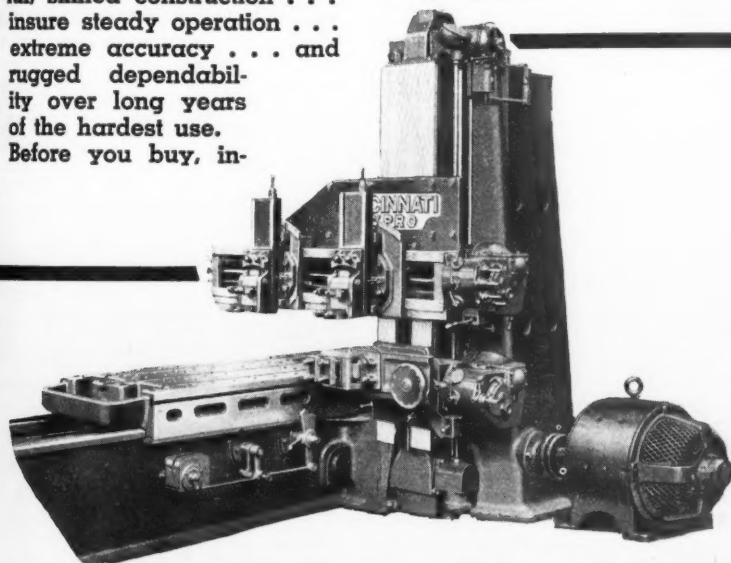
10 CUTTING SPEEDS RETURN SPEEDS

up to 240 feet are available on the
CINCINNATI "HYPRO" PLANER
by the movement of a handle
on the Special Controller.

This, and many other valuable features, give these machines outstanding high productive capacity at a cost low enough to guarantee new profits and quick return on investment.

Advanced design and careful, skilled construction . . . insure steady operation . . . extreme accuracy . . . and rugged dependability over long years of the hardest use. Before you buy, in-

vestigate CINCINNATI Planers, Boring Mills and Planer Millers . . . made in all sizes from 22" to 120". Both Double Housing and Openside. We will gladly furnish you with the location of a machine, now in operation, which is nearest you.



THE CINCINNATI PLANER COMPANY
CINCINNATI OHIO U. S. A.

bodies an electrically-controlled pull-point, and as full-line voltage is used in both relay and power motor, extra responsiveness is secured to repositioning demand. The mechanism is housed in a sturdy, compact, cast iron case which will withstand the rough usage of industrial service.

The Balancer is similar to the Relatrol except that it is provided with an automatic means of load compensation and is recommended where load changes will be of considerable extent and duration. The new Relatrol action employed in these mechanisms can be used in conjunction with many standard pyro-

meters, flow meters, and other measuring instruments, by slightly modifying the contact mechanism. Where Relatrol action is supplied for manual remote control, a hand-operated index and dial replaces the actuating instrument.

Metaline Oilless Bearing, Product of R. W. Rhoades Metaline Company

The Metaline Oilless Bearing, marketed in the New York district by the Spadone Machine Company and announced in the February issue of MODERN MACHINE SHOP, is a product of R. W.

UNIVERSAL STANDARD DRILL BUSHINGS



MADE TO

A. S. A. SIZES

LOWEST COST
LONGEST LIFE
EASILY REPLACEABLE
THERE'S A SIZE FOR
EVERY REQUIREMENT

UNIVERSAL
ENGINEERING CO.
FRANKENMUTH, MICH.

Wet Production Grinding



Cylindrical, Internal, Surface and Collet (centerless) production grinding.

TOOL RECLAIMING by special wet process. 50% off price.

Net. CUTTER GRINDING—Tools, Reamers, Hobs. An immense stock of used H.S. CUTTERS like new at 1/2 price. Send for price list—now.

Machinists' Tool Grinding Co.
3038 W. VAN BUREN ST., CHICAGO, ILL.



PYRO

A self-contained, rugged, quick-acting, accurate and handy portable precision pyrometer, indispensable in any MODERN non-ferrous foundry. Reduce spoilage and secure UNIFORM SOUND CASTINGS. Patented clamping device stops the pointer at correct indication—a PYRO feature. Write for bulletin No. 50.

PYROMETER INSTRUMENT COMPANY
101-105 Lafayette St. New York

CLEAN Machinery is SAFE Machinery . .

The CLEMENTS —CADILLAC

BLOWER — SUCTION CLEANER — SPRAYER

Really **CLEANS** any motors or intricate machinery—thoroughly, safely. Drives **DRY AIR**, free from oil or moisture at great velocity but low pressure. Removes dust, lint, wood or metal particles—reducing risk of "shorts" and "burn-outs", cuts down fire hazard and excess wear. Convertible to sprayer or suction cleaner.

CLEMENTS MFG. CO.,

6655 South Narragansett
CHICAGO, ILL.



Ask for **FREE Trial**

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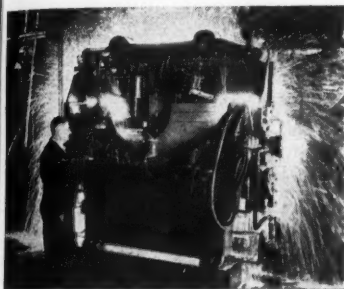
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York

Matching 72 Inches of Hair-Line

From the presses that shaped them, come two steel forms. Placed in this Taylor-Winfield Welder, their two edges, each 72" in contour length, .035" thin, must be accurately matched for butt welding.



"—a fender becomes whole!"

The operator pulls levers—powerful clamps and dies slip into place—two steel faces 72" long and .035" high are brought together—held together (a release of .007" would spoil the job)—upsetting slides are held against cams—an acceleration—a flash—a fender becomes whole!

The entire operation takes less than 45 seconds. The levers are on Ross Operating Valves—seven valves on each welder, controlling air cylinders that actuate slides, dies, clamps. Their performance is swift, clean, positive, economical. They serve a machine that does a job the automotive industry considered impossible.

calculated pressure must be applied, maintained, released in swift sequence—air cylinders do the trick. The control of air cylinders must be quick, delicate, sure. Such control is supplied by Ross Operating Valves—on air chucks, welding machines, vises, riveting machines, power presses, molding machines, pipe threading machines, steel mill equipment.

Ross Valves—operated by hand, foot or Solenoid—control single and double acting air cylinders. They are compact. They are simply installed, easily serviced. Employing the poppet principle, they are capable of speedier operation than other types of valves. Flexible discs, seated by air pressure, assure air-tightness over long periods of use—no grinding or lapping is required. To learn more about the more efficient operation of air cyl-



"quick, delicate, sure"

From Chucks to Steel Mills

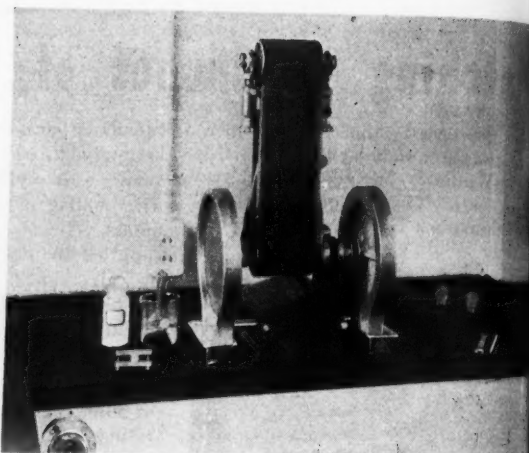
Wherever work is to be held in place or fed to machines—wherever power must be given speed in putting machinery through its paces—wherever

inders on machinery you use or manufacture for sale, write to the Ross Operating Valve Company, 6488 Epworth Blvd., Detroit, Mich.

Rhoades Metaline Co.,
Inc., P. O. Box No. 1,
Long Island City, New
York.

Metallgraphic Polisher

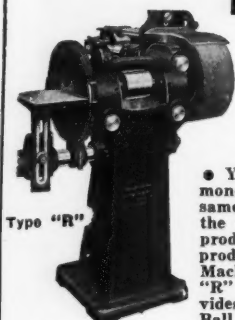
As a companion piece to the Bausch & Lomb Electroplater's Microscope, the H-V W-M Metallgraphic Polisher has been developed recently by the Hanson-Van Winkle-Munning Co., Matawan, New Jersey, to be used for preparing a specimen for the measurement of plate thickness. The polisher consists of a surface grinder with two fabric covered wet polishing disks mounted on the same chassis. The surface grinder may be operated in a horizontal or vertical position and carries a 4x36-inch belt set up with metallgraphic emery. Adjustments are provided for belt tension.



H-V W-M Metallgraphic Polisher

The wet polishing disks are mounted vertically on either side of the drive shaft and are encased in adjustable aluminum splash guards. The polishing cloths are held in place by a spring.

Production Polishing Machines



Type "R"

• You can save money and at the same time improve the quality of your product by using a production polishing machine. This Type "R" machine provides a combination

Ball Bearing Polisher, Surfacers and Disc Grinder. The number of jobs adapted to this machine will surprise you.

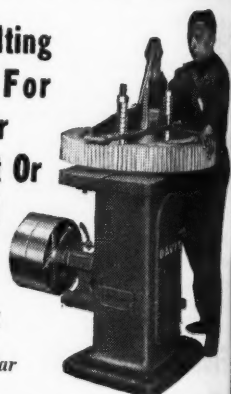
Many other types of polishing machines also available. Write for circulars.

Production Machine Co.
GREENFIELD, MASS.

A New Keyseater

With Tilting
Table For
Either
Straight Or
Tapered
Bores

Send
For
Circular

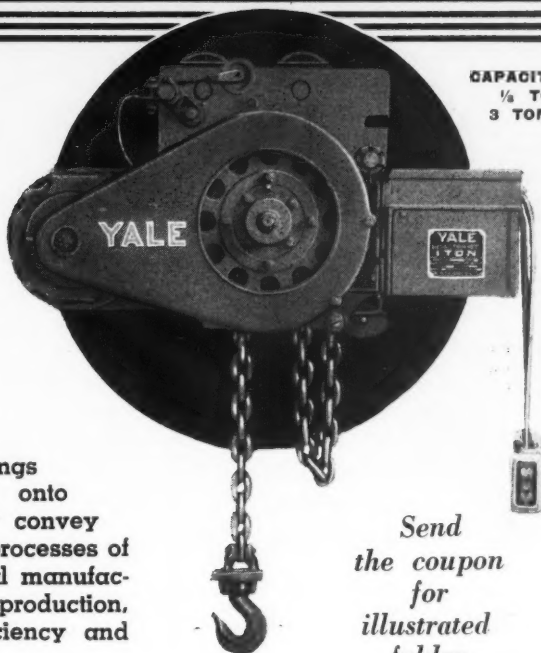


Davis Keyseater Co.

Exchange and Glasgow Sts.
Rochester, N. Y.



BALL BEARING
Electric
HOISTS



CAPACITIES
1/8 TO
3 TONS

the metal
working in-
dustry many
and money
ing applica-
are found
Yale Ball Bearing
Electric Chain Hoists.

they lift heavy castings
and other materials onto
machines and swiftly convey
them through various processes of
machining and general manufac-
ture . . . speeding up production,
promoting safety, efficiency and
economy.

*Send
the coupon
for
illustrated
folder*

Yale Electric Hoists provide maximum ruggedness and strength with simplicity of operation and maintenance.

THE YALE & TOWNE MFG. CO., PHILADELPHIA DIVISION
4533 Tacony Street, Philadelphia, Pa.

Gentlemen:

Kindly send me the illustrated folder containing detailed information with regard to YALE Electric Hoists.

Name of Firm

Individual Title.....

Address

.....

which fits into a groove in the periphery of the disks thus insuring even tension and even balancing of the disks. A removable pan is placed under each splash guard to collect excess polishing suspension. A $1\frac{1}{3}$ h. p. 1750 r.p.m. motor is recommended to drive this machine.

To prepare a specimen, suitable sections are sawed from the plated article and mounted on a clamp that is provided with the outfit. Filing with a coarse file and the No. 2 Pillar file produces a surface that is sufficiently even for polishing. The specimen is first ground on the dry fine emery belt and

then on the first disk covered with duck. A very fine metallgraphic suspension in water is applied to disk with a camel hair brush during operation. The final polishing is carried out on a disk covered with broadcloth to which a suspension of levigated alumina is applied. After washing, drying and in most cases etching, the specimen is ready for examination under a microscope. The preparation of a specimen which may contain up to 24 sections requires 30 to 60 minutes.

Webber Comparator

A comparator designed to provide twin features of simplicity and accuracy has been brought out by Webber Gear Inc., 2517 Vestry Ave., Cleveland, Ohio. The design is based upon the old principle of mechanics—a single lever. The mechanism consists of but two moving parts; the vertical spindle, which carries the contact feeler point, and a horizontal beam which carries the indicating hand. A stationary knife edge supports the horizontal beam and a second knife edge contacts the horizontal beam on the upper side.

The construction is such that it is impossible, through use or abuse, to injure the knife edges. Any surface wear is automatically taken up by spring of $1/60$ ounce pressure, which holds the horizontal beam in contact with the two knife edges. The spindle may be lifted $1/32$ in. to clear the work or the work may be pushed under the contact point without fear of damage. A reading may be repeated any number of times regardless of the direction in which the work is placed under the measuring point. Coarse adjustment is obtained by means of a collar under the head support arm, which also prevents the head from being dropped accidentally. Fine adjustment is obtained

UNIVERSAL COLLET CHUCKS

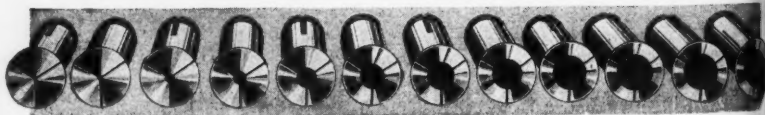
GRIP AS STRONG
AS
SOLID
STEEL

CONCENTRIC
WITHIN
.001



UNIVERSAL
ENGINEERING CO.
FRANKENMUTH, MICH.

RIVETT DRAW-IN COLLETS AND CHUCKS



All lines of "Rivett Mark" Collets including Hender, Cataract, Seneca and Rivett Styles now be purchased from the following stocks:

CHICAGO
R. E. Ellis Engineering Co.
621 Washington Blvd.

BOSTON
Rivett Lathe & Grinder Inc.
Brighton District

DETROIT
Chas. A. Strellinger Co.
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WHY

customers have developed the market for our machines

Haskins Flexible Shaft Equipment is light, portable, durable, easy to use, economical to operate. Quickly adapted for even the most unusual purposes . . . readily moved wherever desired . . . easily changed over from one operation to another. Its flexible shafting permits the use of many different tools in hard-to-get-at places. No wonder our customers are developing new uses for it all the time . . . No wonder nearly a hundred uses have been found already.



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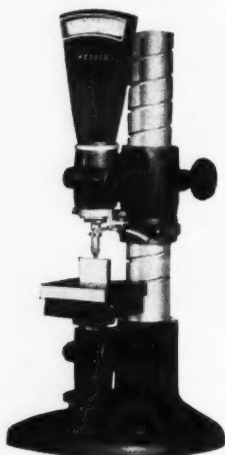
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means of a knurled collar at the base of the table.

The instrument has a work range of



Webber Comparator

0 to 6 in., the range of the scale being ± 0.002 in. The user has an option of

three scales with 0.0001, 0.00005, 0.000025 in. graduations. The measuring error is less than 0.00001 inch. standard contact point is a steel which may be quickly and inexpensively replaced when worn. Diamond contact points can be supplied if required.

The scale is translucent and is read whether the illumination comes from the front or rear of the instrument. A miniature lamp may be stalled back of the scale if desired. measuring head may be used in any position; vertical, horizontal, or inverted. The same comparator may be used for the finest gage inspection or for production gaging. A dovetail slide is provided in the table to which special fixtures can be adapted for special jobs.

Height overall is 18 in., and weight is 45 pounds.

"Wyco" Call System

By using the microphone, control board, and loud speakers shown in illustration, it is now possible for operator in the office to convey a message to any executive in any part of the plant. This system, known as Wyco Call System, is a development of Wyzenbeek & Staff, 642 Washing-



- 11 $\frac{1}{4}$ in. Swing ... Two bed lengths ... 24 and 36 in. center distances ... 1 $\frac{1}{16}$ in. Spindle Hole.

Semi-quick change gear box with gears for cutting 4 to 80 threads per inch.

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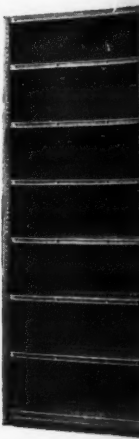
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Specifications

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Centers. Closed Base,
36" Wide—12" Deep
7' 3" High Overall.
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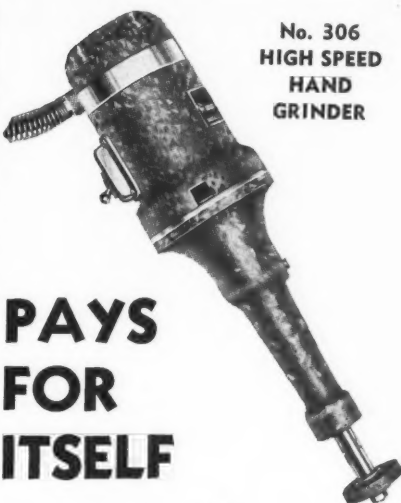
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SAWS for PISTON RING SLOTTING

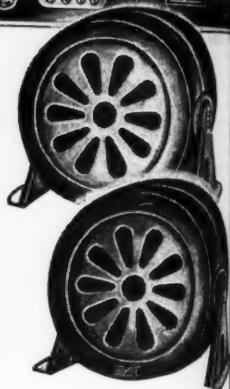
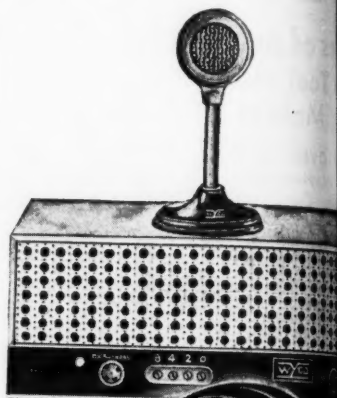
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pends, of course, upon the size of
plant. The equipment is easily instal-
and is both economical and effective

**American Wheelabrator
Multi-Rotary Table**

The American Wheelabrator Multi-
Rotary Table, illustrated herewith, has
been announced by The American For-
dry Equipment Co., 557 Byrkit St., Ma-

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DRILL CHUCKS
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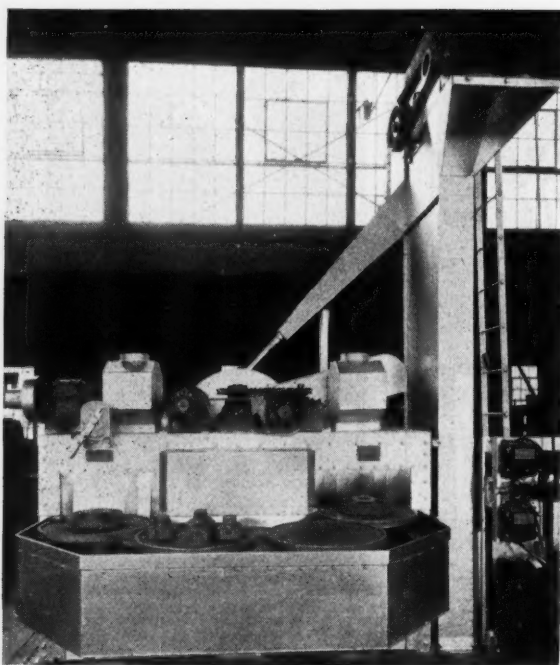
There is a "GUSHER" Coolant Pump for every machine and for every modern cutting need.

In these pumps, simplicity . . . elimination of extra wearing parts and troublesome valves . . . and steady, high volume with low pressure . . . combine to insure marked savings over old pumping methods.

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American Wheelabrator Multi-Rotary Table

awaka, Ind. The Wheelabrator Multi-Rotary Table consists of a series of tables upon which work can be carried through the Wheelabrator for cleaning. Certain types of castings, forgings, or stamped parts which might be scratched, bent, or broken in certain other types of cleaning equipment can be cleaned satisfactorily by the use of an abrasive applied by such a machine as the

Wheelabrator.

The Wheelabrator Multi-Rotary Table consists of a number of independent tables, the number and diameters of which can be varied. The tables are attached to a guide which runs in a track that passes directly under the Wheelabrator and runs in a straight line for approximately 6 ft. Thus the tables are directed under the blast of abrasive from the Wheelabrator, within full blasting range of the abrasive as it leaves the wheel. The flat edge of each table contacts a moving belt which revolves the tables as they pass under the blast. The speed of the belt is variable, thus making it possible to vary the speed with which the tables are revolved as they pass under the Wheelabrator. After traveling through the blast, the tables follow the track out of the cabinet where the work-pieces can be removed or reversed for a second application of the Wheelabrator blast.

In the Wheelabrator equipped with the multi-rotary table a load of abrasive is placed in an overhead hopper from which it is fed, via a chute and control gate, to the center of the Wheelabrator wheel. With the wheel revolving at a high rate of speed, the abrasive is thrown by centrifugal force from the blades of the wheel onto the work to be cleaned. The abrasive can be con-

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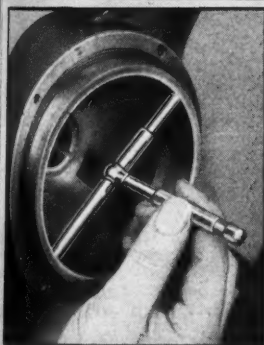
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trolled as to both volume and direction of blast so that any type of cleaning and preparation can be accomplished from a light satin finish on light metal parts to the removal of dirt or scale from heavy castings or forgings. Sizes and types of abrasive can be selected according to the work to be done.

Spent abrasive, after being thrown from the wheel onto the work-piece, falls into a hopper and is fed by screw conveyor and bucket elevator to an overhead hopper for re-use.

General Electric 250-Watt Mercury-Vapor Lamp

Development of a new high intensity mercury-vapor lamp rated at 250 watts of similar design but much smaller than its 400-watt companion lamp, has been



250-Watt Mercury-Vapor Lamp

announced by the General Electric Vapor Lamp Company, 897 Adams St., Hoboken, N. J., and The Incandescent Lamp Department, Nela Park, Cleveland. The lamp is recommended for applications which do not permit the use of the standard 400-watt high intensity mercury-vapor lamp.

The 250-watt mercury lamp has an efficiency of 25-30 lumens per watt. It is of the universal burning type, functioning in the vertical, horizontal, or angular position. The operating life rating of the lamp is 2,000 hours.

The lamp can be used alone or in

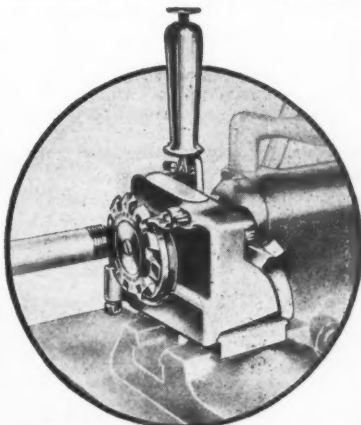
RIVETT IMPROVED THREAD TOOL

Mounts on any screw cutting engine lathe. An unskilled operator can use it. For any diameter or form (except square) of six pitch or finer. THE THREAD TOOL is a holder for a ten tooth cutter with means for indexing the cutter to present each of the ten teeth successively to the work, and with adjustments for controlling the size of the finished thread.

THE CUTTER is a disc of the best tool steel with ten teeth, each tooth having a prescribed increase in radial length over the preceding tooth, thus comprising in effect, ten cutting tools. The first nine teeth rough out the thread progressively in nine heavy measured cuts, and the tenth tooth finishes the thread. The responsibility of the operator is reduced to indexing the cutter when reversing the lathe. The thread tool does the rest.

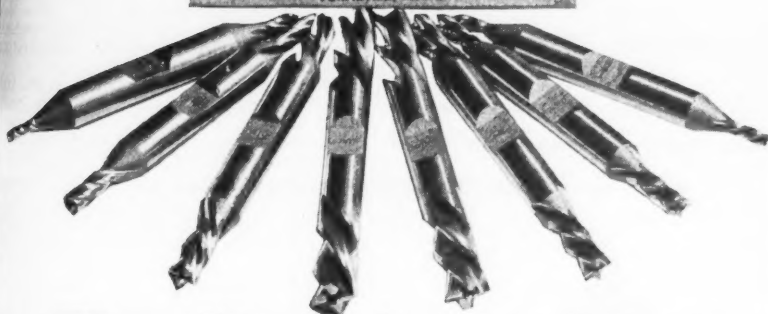
Bulletin 110A

RIVETT LATHE & GRINDER INC.
BRIGHTON, BOSTON, MASS.



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They Shear Cut the Metal

That's why they cut faster and leave that smooth finish. It's the way they are ground that brings results.

Send for a new catalog showing single, double, and other styles.

PROGRESSIVE TOOL & CUTTER CO., FERNDALÉ, MICH.

combination with incandescent lamps. Used alone, it provides high efficiency lighting for use in low bays or other locations where the 400-watt lamp cannot economically be utilized. The mercury-vapor light has the usual characteristic mercury-vapor line of spectrum, however, giving objects a definitely blue-white cast.

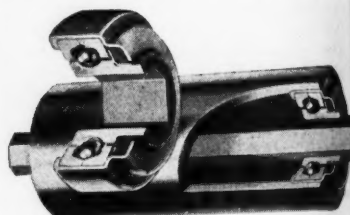
The smaller size, lesser wattage and color characteristics of the new lamp make it particularly adaptable to combination with incandescent lamps the continuous spectrum of which is red. The result of this intermingling is a

synthetic white, a cool light which mixes well with natural daylight.

The 250-watt mercury lamp has standard medium screw base and is 10 in. overall length, with 5 in. light center length. The diameter of the bulb is 1 1/2 in. Finish is clear. A special individual transformer or reactor is required for the proper operation of the mercury vapor lamp. A number of newly designed reflectors of the single and combination types, specifically designed for the 250-watt lamp, are available.

Mathews "Knurled-Keylock" Roller Conveyor with Hexagon Axle

Mathews Conveyor Company, Ellwood City, Pa., announces an improvement in the "Knurled-Keylock" line of roller conveyors manufactured by this firm.



Sectional view showing adaptation of hexagon axle as used in ball bearing conveyor roller. Steel tote pans filled with small parts are conveyed to vertical elevated conveyor as in bearing roller conveyors.

the form of a roller designed to incorporate a hexagon-shaped axle. The hexagon axle will be used in all the present sizes in addition to several intermediate sizes not heretofore available.

The rollers are of seamless steel tubing with hardened steel bearing parts with solid inner and outer ball races predominating. Ball bearing roller lengths to suit are available in the full

STEELGRIP Belt Lacing

A stronger lacing (treated steel) in sizes and widths for ALL power transmission and ALL conveyor belts. Compresses belt ends, prevents fraying and adds to life of belt. 8 sizes. Comes boxed in convenient lengths or in special extra lengths. Furnished in Monel Metal for use under corrosive conditions. Write for catalog and prices.

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ARGUTO OILLESS BEARING CO.

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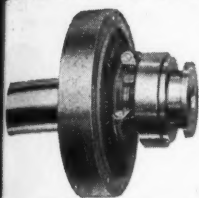
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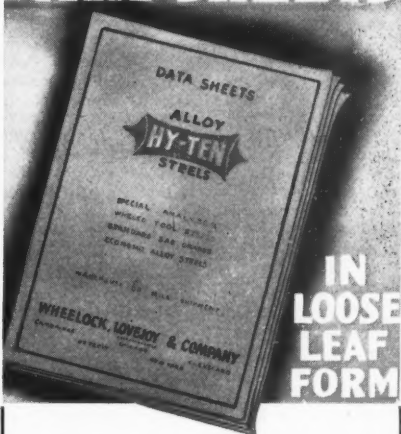
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Give this clutch a trial on your hardest job first. Its reliability will soon show the savings that can be made by installing "Type SF" Clutches on other machines. Our Engineering Department gives special attention to your clutch problems.

Write us we can help you.

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MECCHANICAL engineers, executives, superintendents, and purchasing agents, will find these data sheets of prime value for specifications of materials for machine tool parts covering:

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lowing diameters: 1, 1½, 1.9, 2½, 2¼, 2½, 2¾, 3¾, 3½, 3¾, 4, 4¼, 4½, 5, 5¾, and 7¾-in., with capacities ranging from 50 lbs. continuous load rating for the 1 in. diameter roller to 8000 lbs. for the 7¾ in. diameter roller.

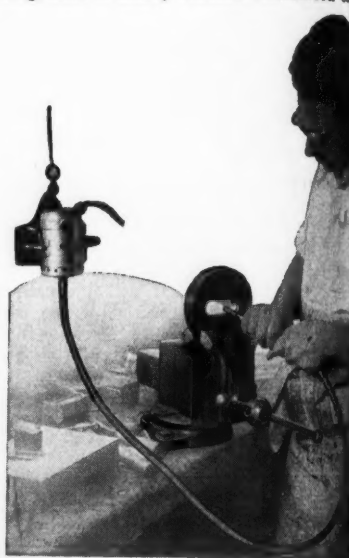
Additions to the hexagon axle line include the following: a tapered steel roller 2½ in. to 1¾ in. diameter, capacity 150 lbs.; a 2½ in. diameter roller for heavy service, capacity 300 lbs.; a 3 in. diameter roller of 750 lbs. capacity; a 3½ in. diameter roller of 1200 lbs. capacity; a 4 in. diameter roller of 3000 lbs. capacity; a 4½ in. diameter roller of 4000 lbs. capacity. This line permits a choice of size and capacity for practically all sizes of handling where ball bearing rollers are required.

Stanley ¾ H.P. Flexible Shaft Grinder

A portable, flexible shaft grinder that develops ¾ h.p. and a speed of 18,000 r.p.m. is now being manufactured by The Stanley Electric Tool Division, New Britain, Conn. The grinder is especially adapted for a wide variety of external and internal grinding operations on tools, dies, castings, and so on. The

¾ h.p. universal motor provides ample power to drive a ½ x ½-in. emery wheel and maintain a high grinding speed on the toughest work.

The flexible shaft, which is 42 in. long, has a heavy rubber-reinforced



Stanley ¾ H. P. Flexible Shaft Grinder

ing with protection springs on each end. The handle piece is equipped with special ball bearings and a collet-type chuck to hold ¼-in. shanks. The cradle which is furnished with the grinder will hold the motor unit on a bench, or it can be suspended overhead.

The grinder is shipped ready for use except for grinding mediums. However,

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(NEW 1936 EDITION)

• 128 pages of gears, reducers, sprockets, pulleys, couplings, chain, etc. Engineering Data. Helpful hints



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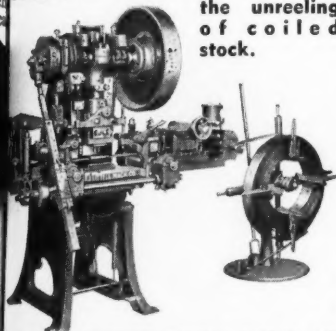
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AUTOMATIC FEEDS for all sizes and makes of punch presses.

AUTOMATIC CENTERING REELS for the unreeling of coiled stock.



Punch Press Equipped with a Littell No. 3 and Pinion Roll and d, Straightener, Scrap Cutter, and No. 3 Reel.

PUNCH PRESS AIR VALVES and UNIVERSAL AIR NOZZLES for the safe and quick ejection of work pieces.

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Pioneers in the riveting field. Head rivets from smallest to $\frac{3}{4}$ " diameter, either by noiseless spinning or vibrating hammer method—Sizes to meet all needs—Types include Vertical and Horizontal Multiple Spindles.

Write for literature—and don't forget to send samples.

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96 Silliman Avenue Bridgeport, Conn.

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SMALL INVESTMENT IN ATLAS DRILL PRESS DOUBLES PRODUCTION

Reynolds Electric Company, prominent electrical product manufacturers of Chicago, find Atlas Drill Press equipment efficient and economical. They are turning between eighteen hundred and two thousand threads per hour in steel with an Atlas Model 70. The press is running full time.

DOES 5 HOUR JOB IN 2 HOURS

The purchase represented a very large saving, the price being only a fraction of other equipment considered. With this same Atlas, Reynolds is now doing in two hours a tap job that formerly required five hours on regular tapping outfit.

Atlas Drill Presses are standing up under this and any other similar jobs and maintaining their accuracy. They will do the same in your plant. Made in four sizes, bench and floor models. Prices range from \$14.45 to \$39.45. See them at your jobbers or write direct for new 1936 catalog.

ATLAS PRESS COMPANY

6 N. Pitcher St. Kalamazoo, Mich.
Complete display at Atlas Sales Co., 35 E. Wacker Dr., Chicago.



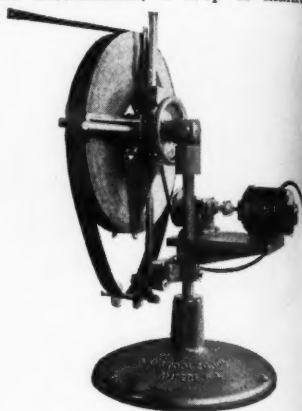
the manufacturer of the grinder carries a complete line of arbors, spindles, emery wheels, and mounted points for use with the machine.

U. S. Automatic Stock Reel

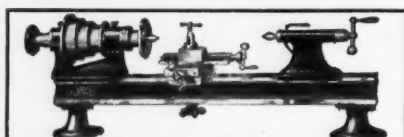
To provide a means of preventing the whipping action and strain on stock which commonly occurs where heavily-loaded reels are operated, where long feeds are run at high speeds, or where light materials are fed, the U. S. Tool Company, Inc., Ampere, N. J., has developed the automatic stock reel shown

in the illustration. The reel is motor driven, eliminating all pull on the stock and providing a brake which prevents the stock from unwinding too fast.

By means of a simple, yet highly efficient mechanism, a loop is maintained



U. S. Automatic Stock Reel



Ames "Dual Use" Bench Lathe

Special design for making interchangeable parts and finest tool and instrument work. Write for blue catalogue.

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RIVETING?

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Send Samples of your Work and we will furnish accurate estimate of production and quote cost of equipment.

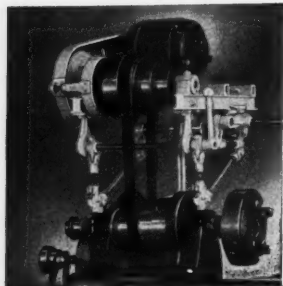
LINLEY BROTHERS CO.
583 Fairfield Avenue
Bridgeport, Conn., U. S. A.

in the stock which prevents pull against the reel and against the stock. The stock reel is made in both vertical and horizontal quick-loading types, and can be supplied in a variety of sizes and capacities.

Bull Dog "Vacu-Break" Switch

The illustration shows the Bull Dog "Vacu-Break" Safety Switch which has been brought out by the Bull Dog Electric Products Co., 7610 Jos. Camp Ave., Detroit, Michigan. The switch is available in three complete lines: Master Type A, Standard Type C, and Junior Type D.

The "Vacu-Break" switch is said



REMCO MOTOR DRIVES

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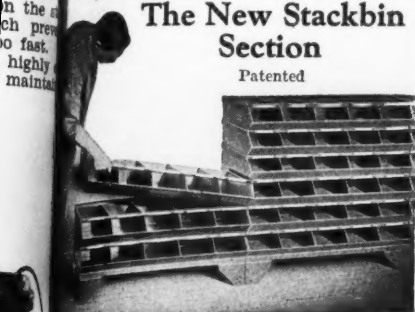
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The New Stackbin Section

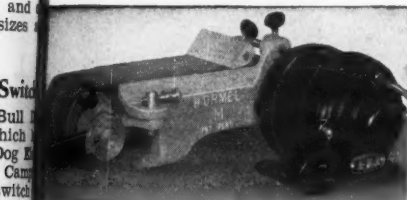
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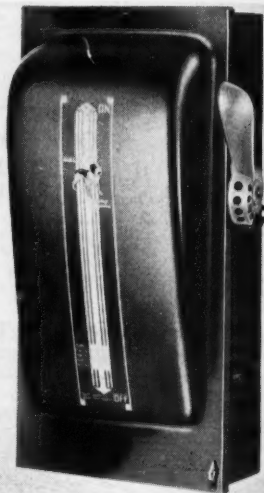
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represent a new and highly effective principle of switch construction. The design reverses the usual procedure and puts the arc-extinguishing structure on the moving contact (blade) instead on the stationary contact (jaws). This construction, together with certain other features, is said to result in unusual high circuit-rupturing ability.

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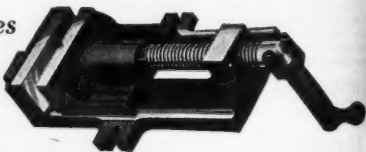
Bull Dog "Vacu-Break" Switch

is totally enclosed except for two slots at the bottom to receive the dual stationary contacts in separate coils. The chamber, in which the moving contact is floatingly supported, moves with the moving contact in and out on the stationary contacts as guides. The piston

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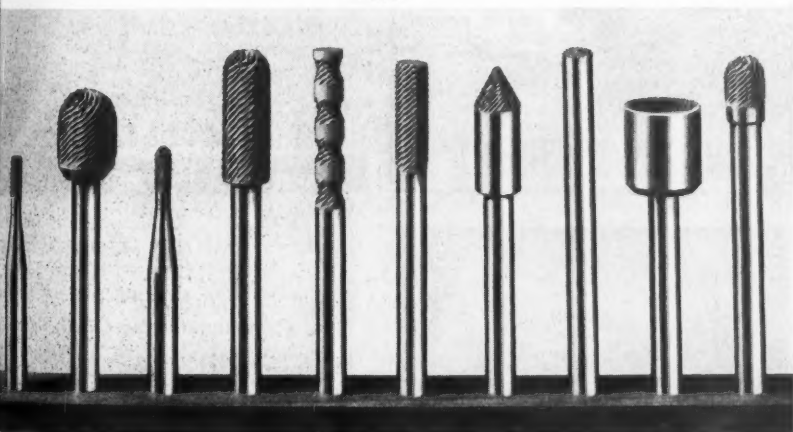
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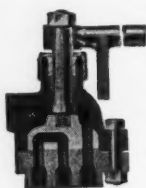
88 HARRISON STREET **M. A. FORD MFG. CO.** DAVENPORT, IOWA

action of the contacts when rupturing in this close-fitting arcing chamber tends to evacuate the small amount of air present in such a restricted enclosure, thus minimizing burning of the arc chamber or contacts by reducing the oxygen available to support combustion. The result is that the amount of ionized gas present to conduct the arc incident to rupturing the circuit is restricted, and the close-fitting arc chamber is the efficient deionizing medium for what little ionization does occur.

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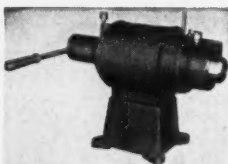
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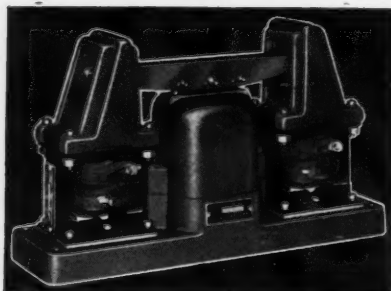
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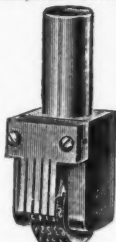
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saving of lathe grinding are brought within the reach of every shop and tool room.

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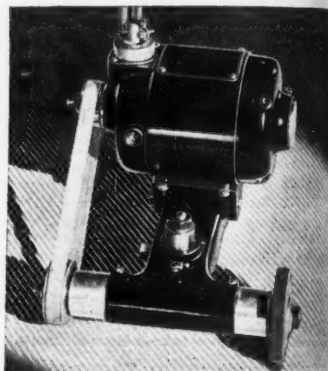


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Dumore No. 44 Toolmaker

mounted wheel with $\frac{1}{4}$ -in. shank; one 2-in. vitrified wheel; one 3-in. vitrified wheel; two "Hi-Speed" fabric belts and three assorted wrenches.

L-W Lathe Chuck

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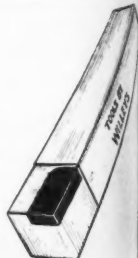
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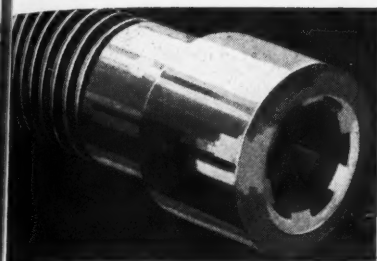
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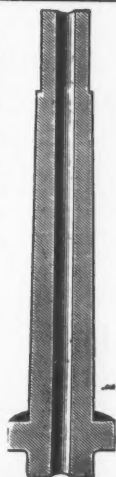
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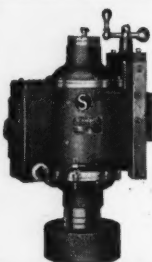


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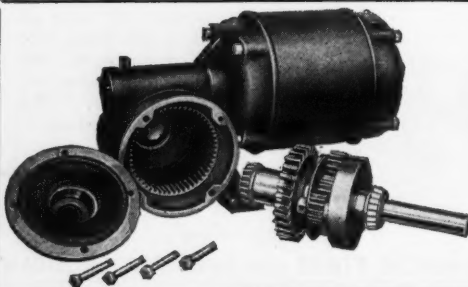
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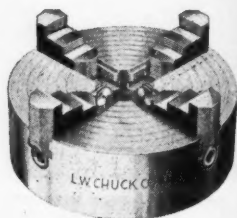


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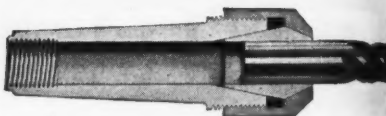


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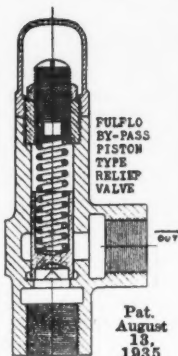
Universal Collet Chuck

take shanks from 1/8 to 3/8 in. diameter and type ZZ will take shanks from 1/2 to 1 in. diameter.

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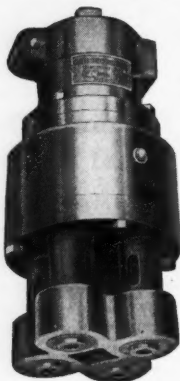
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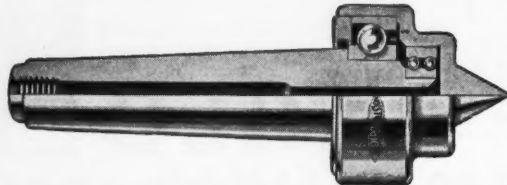
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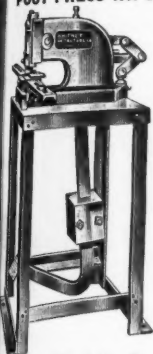
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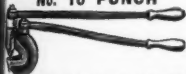


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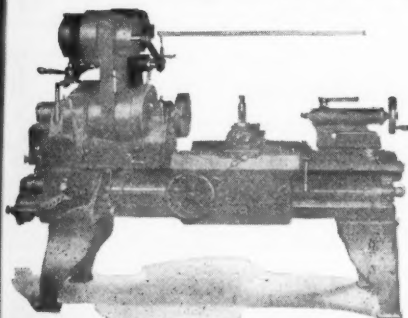
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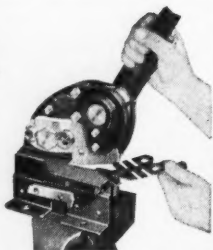
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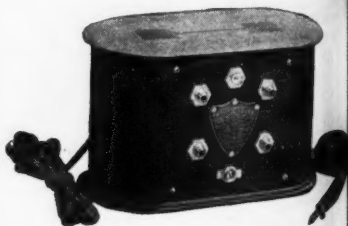
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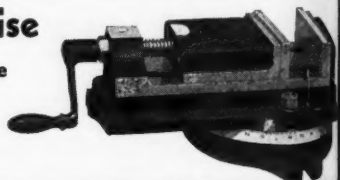
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For External, Internal and Surface Grinding Machines

The Vinco Angle Tangent to Radius Dresser will dress angles and radii tangent to each other on Abrasive Wheels for less than 25 % of the cost of any other method. It is the only Angle Tangent to Radius Dresser on the market, and is an absolute necessity for the accurate and economical dressing of forms on abrasive wheels. This Dresser has eliminated waste, worry and inaccuracy in many tool rooms throughout the U. S. A. and Canada. It is precision made of the finest materials and fully guaranteed to be satisfactory.

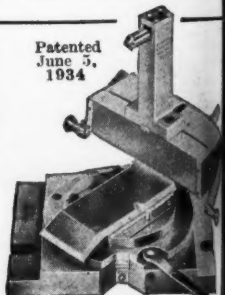
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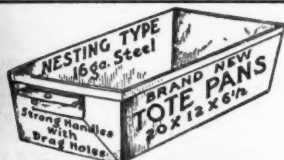
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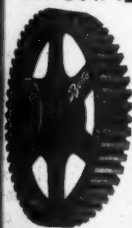


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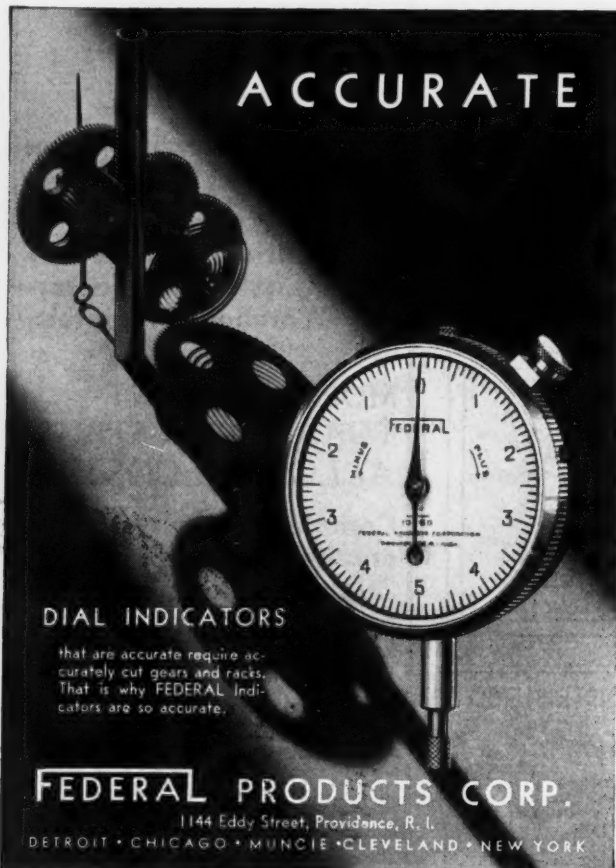
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is built for hard use and is attached to a heavy duty cord. The Frampton operates on 110-volt, 60-cycle current.

BONDTRU FLEXIBLE INSULATED COUPLING. This 4-page folder, issued by Charles Bond Company, 617-A Arch St., Philadelphia, Pa., presents the Bondtru Flexible Insulated Coupling. The design and construction of the coupling are explained in detail and all parts of the coupling are illustrated. Copy free upon request.



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that are accurate require accurately cut gears and racks. That is why FEDERAL indicators are so accurate.

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Send for New 1936 Catalog No. 37

Pease Non-Bleeding and Color Fast Blue-Print Papers and Cloths

The C. F. Pease Company, 855 North Franklin Avenue, Chicago, Illinois has developed a blue print paper and cloth that will not "bleed". The non-bleeding feature of the new Pease "K" speed paper and cloth has discredited the old theory in blue printing that prints are burned out or over-exposed when white lines do not show up clear and strong. The only method of overcoming this condition has been by over-exposing the

prints with the resultant sacrifice of the deep blue color. By using the new Pease "K" speed paper or cloth, it is said that prints may be fully exposed—even over-exposed—and still produce a deep lustrous blue and permit the whites to stand out clear and sharp.

The non-bleeding feature is equally advantageous in making blue line prints. It is unnecessary to block out behind each blue line print and such prints can be printed, washed, and dried without a trace of blue streak or blur. The non-bleeding quality also permits an unusually wide range of exposure. Because of the color fast feature, prints of the new "K" speed paper and cloth can be produced which are said to be the nearest to non-fading that it has ever been possible to attain.

Pease "K" speed papers and cloths are available in all standard lengths, widths, weights, and rag stock content, in rolls or standard cut sheets



Superior High Speed by method many years and you of Higher and Smo

The Mill for your

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This Grinding on its side racy 50% insure that holes ductio

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Webber Comparator

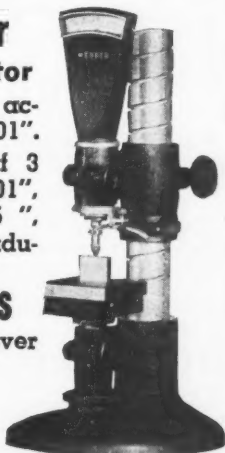
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NO GEARS
Knife edge lever movement.

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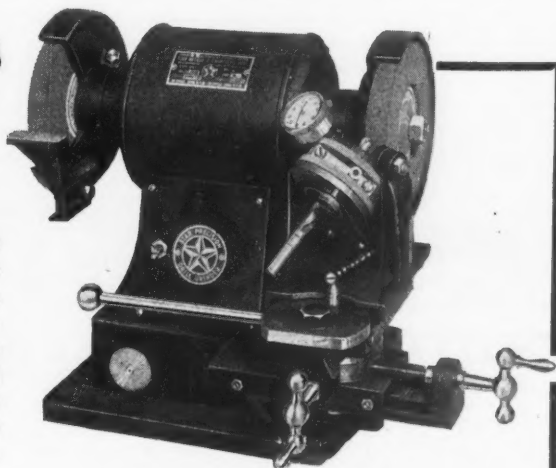
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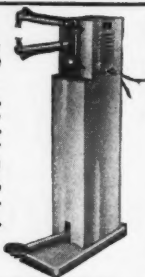
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With water-cooled electrodes, for continuous production, maximum 2 pcs. 16 Ga. C. R. Steel. Complete with stand.

PRICE, ONLY \$75.00

Sample welds and literature on other sizes upon request.

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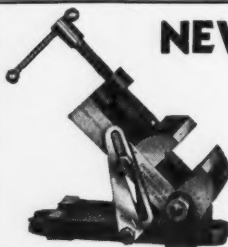
sizes. Free sample prints with prices may be obtained by addressing the manufacturers as above.

Radiographic Inspection

(Continued from Page 38)

piece. Lead markers are placed on the outside of the casting to identify the area examined, thus each negative carries its own identification and there is no danger of mistakes even when a great number of negatives are required to cover a single casting.

X-ray equipment designed primarily for routine examination of welded seams in pressure vessels is shown in Fig. 11. The equipment can, however, be used with equal facility for the inspection of castings. The vessel to be inspected is supported on two sets of gear-driven rolls which are mounted on trucks that can be moved along a track to accommodate vessels of different lengths or clear protruding nozzles or manways. The roll-and-gear units can be adjusted



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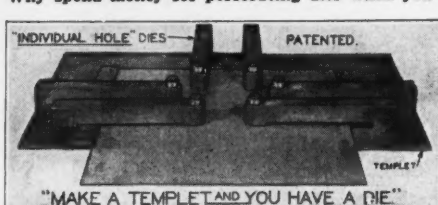
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WIDTHS 2 1/4"
OPENS 3"
DEPTH 1 7/16"
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WEIGHT 10 LBS

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Why spend money for perforating dies when you can shift these "INDIVIDUAL HOLE"



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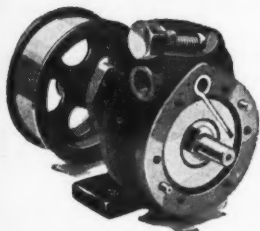


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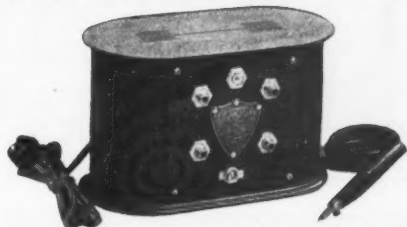
It contains the definite data engineers want when they're selecting coolant and lubricant pumps. It describes **ROLLWAY PUMPS** as engineers want them described —no sales talk—no ballyhoo. Ask for a copy for your files.

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THE M-B SUPER SPEED AIR GRINDER

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on the trucks to accommodate vessels of different diameters.

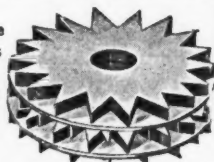
The X-ray generator and tube are mounted on a car which travels parallel with the car on which the work is mounted, as shown in the illustration. The lead safety box in which the tube is located can be tilted so that the X-ray beam can be directed at any angle between 30 deg. above and 30 deg. below the horizontal. The X-ray car is powered by a slow-speed electric drive under push-button control, and the vessel is rotated by means of a gear drive.

The principal undesirable conditions in welded seams that are revealed by radiographic examination are as follows:

1. No penetration; that is, a lack of proper fusion between the weld metal and the parent metal. A defect of this type is illustrated in Fig. 12, which shows a section of electric

Grinding Wheel Dressers

We make
all types
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Dressers
and
Cutters

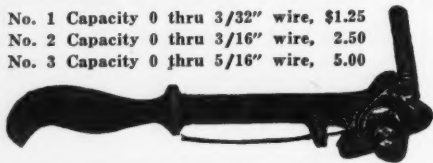


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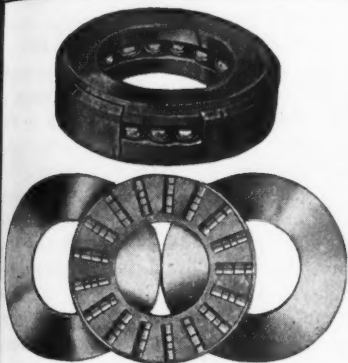
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Will Earn Its Cost in one Day

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WOBURN, MASS.



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ROLLER THRUST BEARINGS
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Special Bearings Made to Order.
Send Sketch or Sample for Quotation.

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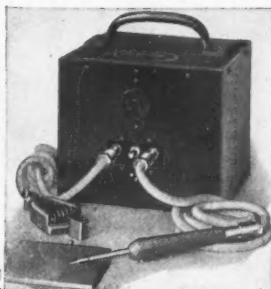
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with the *Echograph*

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**NEW
BABY
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MODEL**

**LOW
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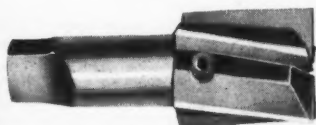
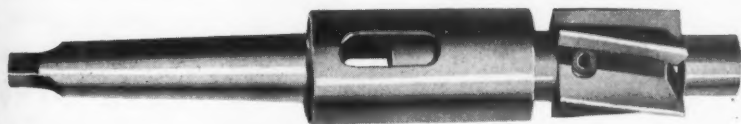
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• Style "B" counterbores have standard stub taper shanks for insuring alignment. An uneven number of flutes eliminates the chatter.

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Precise, Accurate, Dependable
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One-quarter inch to eight inches.

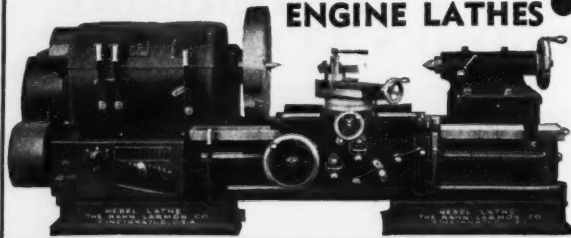
The Comtor Company
Waltham, Mass.

weld in a $\frac{3}{4}$ -inch plate. The defect is indicated by the white lines.

2. Lack of proper fusion between layers of weld metal. Such a condition, occurring in a welded seam in $2\frac{1}{2}$ -inch plate stock, is shown in Fig. 13. The improper fusion is probably accompanied by slag inclusions.

3. Gas inclusions. These gas pockets, more or less numerous throughout the weld zone, comprise the most common type of defect observed in welds. As shown in Fig. 14, they occur as sharply-defined rounded spots. Although the exograph showed this weld to be somewhat porous, it could be considered suitable for the service intended. This exograph provides an opportunity, however, to point out the danger of inexperienced radiographic inspection, inasmuch as a picture may show an apparently bad condition which is actually permissible. X-ray inspection is a rigid test

GEARED HEAD & CONE DRIVEN ENGINE LATHES

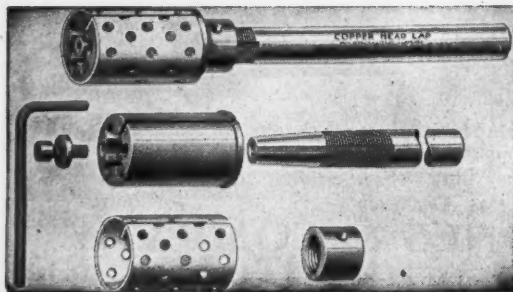


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VARIOUS WIDTHS
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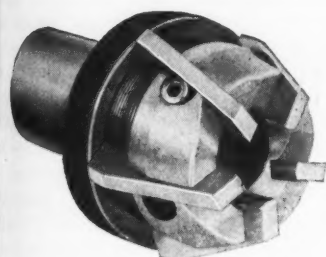
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SEVEN DIFFERENT STYLES

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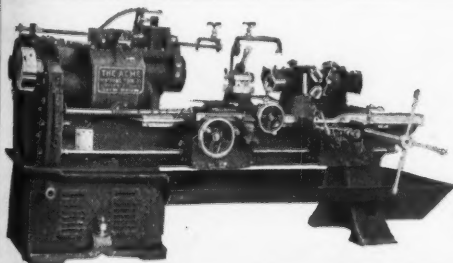
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Our engineers will solve your
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Write us or send blue prints.

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GEARS

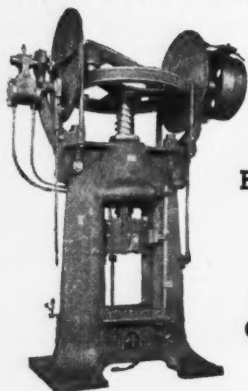
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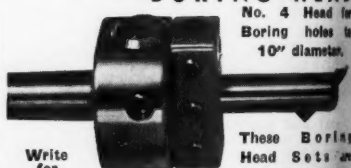
Newark, N. J.

calling for skill in the interpretation of the films and a thorough knowledge of the use to which the subject materials are to be put.

A typical exograph of a sound weld is shown in Fig. 15. The weld itself can not be distinguished from the plate; only by reference to the lead markers can the weld zone be determined. With the proper welding technique such welds are being made continually. An exograph of a sound weld is shown in Fig. 16.

Radiographic examination of welds is made not only as a final check but also for the purpose of perfecting the welding technique. By means of X-ray examination it was discovered, for instance, that a certain type of electric arc gave the best results for a given type of welding operation. A stronger current were used, the exograph showed porosity in the welds; if the current were too weak

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These Boring
Head Sets are
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No Leveling
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A simple
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They are made in
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Swing	Greatest Distance Between Standards	Capacity in lbs.
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60 in.	30 in.	2,000
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96 in.	88 in.	10,000



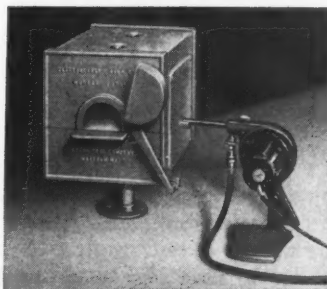
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STARK TOOL CO.

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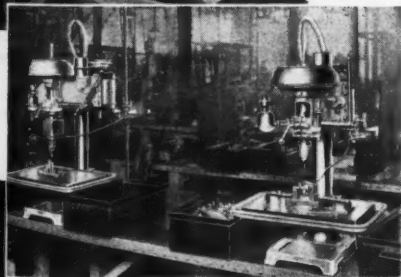
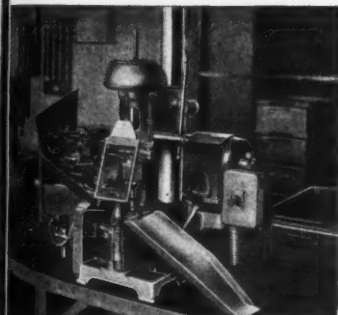
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Upper photo shows a Delta bench drill press in the plant of the Claus Mfg. Co., fitted as a milling machine for milling a 5/16" flat on 1 1/32" diameter gas-cock stems. The milling cutter is carried on a Delta circular saw arbor, and the work is fed to the cutter with the regular drill-press quill feed. Production is 1200 pieces per hour. The complete Delta line includes both bench and floor type models, multi-spindles, special production tables—and are priced as low as \$29.85. For full details and name of nearest Delta dealer write to:

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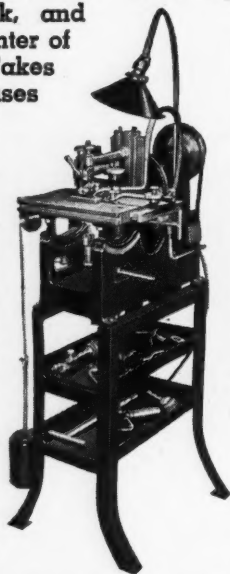
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Volume 8

A Magazine for Mechanical Executives: Construction Production Maintenance

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